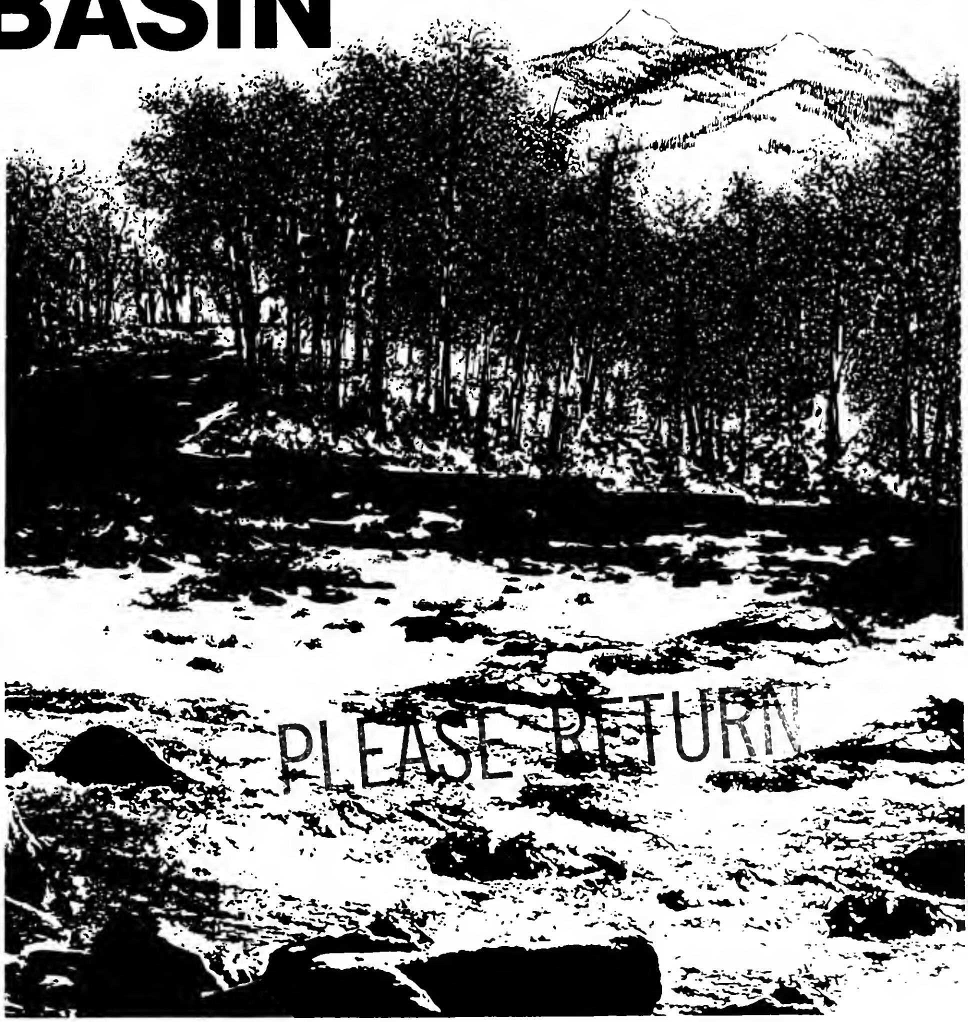
# UPPER CLARK FORK BASIN WATER RESERVATION APPLICATIONS

ADDENDUM





Draft Environmental Impact Statement

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

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NOTICE

MARCH 16, 1990

The Department of Natural Resources and Conservation (DNRC) recently completed an addendum to its draft environmental impact statement on reservations of water in the Clark Fork basin above Milltown Dam. Reservations of water are sought by the Granite Conservation District and the Montana Department of Fish, Wildlife and Parks. The addendum presents an analysis of Granite Conservation District's Boulder Creek water reservation request. Copies of this addendum are being circulated for public review and comment for 30 days, ending April 16, 1990.

Persons making written comments should address comments to:

John Tubbs
RE: Clark Fork Reservations
Department of Natural Resources and Conservation
Water Resources Division
1520 East Sixth Avenue
Helena, MT 59620-2301

In addition, a public meeting will be held to receive written or oral comments on the addendum. The meeting will be held at the Drummond Community Hall, April 4, 1990, and will start at 7:00 pm. This addendum and notice were prepared pursuant to the Montana Environmental Policy Act and the Montana Water Use Act. Copies of the addendum and this notice were filed with the Governor and the Environmental Quality Council on March 16, 1990. Additional copies of this addendum and the draft environmental impact statement can be obtained by calling (406) 444-6637, or by writing to DNRC at the address listed above.

Sincerely,

John E. Tubbs
John E. Tubbs
Water Management Bureau
Water Resources Division

# Draft Environmental Impact Statement

# ADDENDUM

## FOR WATER
## RESERVATION APPLICATIONS IN THE

# UPPER CLARK FORK BASIN

March 1990

Montana Department of Natural Resources
and Conservation

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## EXECUTIVE SUMMARY

The Granite Conservation District (GCD) has requested that the Board of Natural Resources and Conservation grant it a water reservation for an irrigation project. GCD proposes constructing an 8,500 acre-foot (af) reservoir in Boulder Creek, a tributary of Flint Creek. The water would be released into a canal at the base of the proposed dam and flow some 33 miles to irrigate 4,093 acres. The total amount of water needed to irrigate this land is 13,998 af. This land is now used for grazing and is located south of Drummond on the benches above and east of Flint Creek.

The irrigation project would substantially reduce flows in Boulder Creek. On average, Boulder Creek flows at Maxville would be reduced by 13,319 af (38 percent) annually and by as much as 94 percent in September. At the mouth of Flint Creek, annual depletions would average 5,309 af. The annual depletion at the mouth of Flint Creek is less than at Boulder Creek near Maxville due to irrigation return flows.

Flow reductions would adversely affect fish populations in Boulder Creek and would also decrease power production at downstream hydropower facilities on the Clark Fork main stem. The reservoir would inundate approximately 145 acres including a county road that provides access to Princeton and areas above Princeton. An additional 206 acres would be affected by construction of a 33-mile canal. The canal route crosses over old landslides between Boulder Creek and Gird Creek. Canal seepage would be large in the landslide areas and there is the potential for canal failure.

DNRC has determined that the costs of the proposed project outweigh the benefits of irrigating and growing alfalfa on the 4,093 acres. DNRC estimates that the project would cost $30.4 million to construct and operate. GCD estimates that the project would cost $14.2 million. DNRC's economic analysis looked at 300 different forecasts of crop prices and yields. The project did not return enough revenue to overcome DNRC's cost estimate in any forecast and only exceeded GCD's cost estimate in one third of the forecasts. If the project received substantial state and federal subsidies, it could be financially feasible to develop for local ranchers and would benefit about 20 ranch families. DNRC did not find any alternative that was economically feasible.

## ABBREVIATIONS

| | | |
|---|---|---|
| af | -- | acre-feet |
| ARM | -- | Administrative Rules of Montana |
| ASCS | -- | Agriculture Stabilization and Conservation Service |
| AUM | -- | animal unit month |
| BHES | -- | Montana Board of Health and Environmental Sciences |
| Board | -- | Montana Board of Natural Resources and Conservation |
| BPA | -- | Bonneville Power Administration |
| cfs | -- | cubic feet per second |
| DFWP | -- | Montana Department of Fish, Wildlife and Parks |
| DHES | -- | Montana Department of Health and Environmental Sciences |
| DNRC | -- | Montana Department of Natural Resources and Conservation |
| DSL | -- | Montana Department of State Lands |
| EIS | -- | environmental impact statement |
| EPA | -- | United States Environmental Protection Agency |
| FEMA | -- | Federal Emergency Management Agency |
| FERC | -- | Federal Energy Regulatory Commission |
| GCD | -- | Granite Conservation District |
| kv | -- | kilovolt |
| kWh | -- | kilowatt-hour |
| MCA | -- | Montana Codes Annotated |
| MEPA | -- | Montana Environmental Policy Act |
| mg/l | -- | milligrams per liter |
| MPC | -- | Montana Power Company |
| USDA | -- | United States Department of Agriculture |
| USDI | -- | United States Department of the Interior |
| USGS | -- | United States Geological Survey |
| WWP | -- | Washington Water and Power Company |

# CHAPTER ONE
# INTRODUCTION

The purpose of this addendum to the draft environmental impact statement (EIS) is to examine the consequences of granting a water reservation to the Granite Conservation District (GCD) for a proposed irrigation project. The proposed 8,500 acre-foot (af) Boulder Creek reservoir would provide water to irrigate 4,093 acres on the bench lands along Flint Creek, south of Drummond. The draft EIS (DNRC 1988) presented information on GCD's proposed project on the North Fork of Lower Willow Creek and on the Department of Fish, Wildlife and Park's (DFWP) application for instream flow reservations in the upper Clark Fork basin.

GCD included the Boulder Creek project in its original reservation application (GCD 1987) as filed with the Department of Natural Resources and Conservation (DNRC). In a preliminary engineering analysis of the project, however, it appeared that construction of the reservoir would be infeasible. DNRC's director met with GCD board members to discuss the project in the spring of 1988. At that meeting, the director felt that GCD would withdraw its request on Boulder Creek. However, DNRC did not receive any written notice of the withdrawal.

After the upper Clark Fork basin draft EIS was published, GCD told DNRC officials that no decision had been made to withdraw the Boulder Creek proposal. On July 27, 1989, the GCD board chairman sent a letter to DNRC stating GCD's intention to pursue the Boulder Creek project throughout the reservation process so that the Board of Natural Resources and Conservation (Board) could make the final decision (a copy of this letter is provided in Appendix C). GCD's decision to pursue the Boulder Creek project necessitated the publication of this addendum to the draft EIS.

## COMMENTS ON THE DRAFT ADDENDUM

Early in 1987, DNRC asked state and federal agencies and other organizations to identify the issues that should be examined in the EIS. The Boulder Creek project was considered, as were GCD's proposed North Fork of Lower Willow Creek project and DFWP's requests for instream flow reservations. Written comments were received from the U.S. Forest Service, the Bonneville Power Administration (BPA), the City of Missoula, the U.S. Environmental Protection Agency (EPA), and the Flint Creek Water Users' Association. Other state agencies that were asked about their concerns included the Department of Health and Environmental Sciences (DHES), the Department of Commerce, the Department of Agriculture, the Department of Revenue, and the Department of State Lands (DSL). DNRC also invited county commissioners, local planners, representatives of irrigation districts, and water users' associations to participate.

DNRC held public meetings in Anaconda, Drummond, and Bonner on March 30 and 31, and April 1, 1989, to present information on the proposed reservations and to

gather comments from landowners, water users, and other interested parties. Issues discussed included water availability and water rights, the possibility of leaving some water unallocated, and the effects of stream dewatering on water quality, aquatic life, municipalities, hydropower producers, and industry. Participants discussed the benefits of irrigation development, including jobs, benefits to the local economy, and increased recreational opportunities provided by new reservoirs. DNRC used these comments to help decide which issues should be discussed in the draft EIS and in this addendum.

After the draft EIS was published, DNRC received numerous comments concerning information presented on DFWP's requests for instream flow reservations and GCD's North Fork of Lower Willow Creek reservation request. The deadline for comments on the draft EIS was March 16, 1989. Responses to these comments will be presented in a final EIS, which will be published after comments are received on this draft addendum.

DNRC will respond only to substantive comments on this addendum that relate directly to the Boulder Creek project, its possible impacts, and to DFWP's instream flow requests on Boulder Creek and downstream reaches. DNRC does not intend to respond to comments that focus on DFWP's instream flow requests or GCD's North Fork of Willow Creek project. As mentioned above, previous opportunities for such comment have been given. All comments will be printed in the final EIS.

## MONTANA WATER LAW AND RESERVATIONS

Water use in Montana is generally guided by the legal principle known as the prior appropriation doctrine, "first in time is first in right." A user's right to a specific quantity of water depends on when the use began. The first person to use water from a source established the first right, the second person was free to divert flows from what was left, and so on. During a dry year, the person with the earliest date of use would have first chance at the available water to the limit of his established right. The holder of the second earliest priority date would have the next chance, and so on.

After passage of the Water Use Act in 1973, a permit must be issued by DNRC in order for water users to obtain a water right. A general adjudication is being conducted statewide by the courts to determine the validity of claims for pre-1973 water rights. The nature and extent of these claimed rights will not be determined until a final court decree is entered. A final decree specifying existing rights for the Clark Fork basin including the Flint Creek basin is not expected in the near future.

When the 1973 Legislature passed the Montana Water Use Act, it also allowed public entities to reserve water for present and future beneficial uses such as irrigation, maintenance of instream flows, and the protection of water quality. Although DNRC processes applications for reservations, the Board makes the decision to grant or deny a reservation. The Board may grant all or part of the water requested

and may place conditions on the reservation. The Board may not grant a reservation unless an applicant satisfactorily establishes:

1. the purpose of the reservation,
2. the need for the reservation,
3. the amount of water necessary for the reservation, and
4. that the reservation is in the public interest.

The granting of a reservation establishes a legal right similar to other water rights in Montana. If set aside for irrigation, the water may go unused until the irrigation project is built or until a time specified by the Board has passed. An applicant must show diligence in putting the reserved flows to use. To date, reservations have been granted only in the Yellowstone River basin. In the Yellowstone reservations, the Board set a deadline of 30 years by which time the water reserved for consumptive purposes had to be put to beneficial use.

Once reservations are granted, only flows exceeding other water rights and those protected by the reservations will be available for appropriation. **Reservations cannot adversely affect water rights in existence at the time the reservation is granted** (Section 85-2-316(9) MCA). However, a reservation can be used as a basis to object to future permits or changes of existing water rights.

The priority date of any reservation application filed with DNRC before October 1, 1989, is the date that the Board grants the reservation. The Montana Legislature recently passed a bill amending the statute concerning the establishment of a priority date. Senate Bill 447 states that reservation applications or notices of intention to apply for a water reservation filed with DNRC after October 1, 1989, will receive a priority date "from the filing." All pending reservation applications in the upper Clark Fork basin were filed before October 1989. To maintain the intent of HB 447, DNRC will not accept notices of intent or reservation applications for water in the upper Clark Fork basin until the Board has made final decisions on the reservation requests from GCD and DFWP.

The Board may extend, modify, or revoke a reservation if it is shown that the objectives of the reservation are not being met. The Board may also reallocate an instream flow reservation to a qualified reservant if the Board finds that all or part of the reservation is not required for its purpose and the need for the reallocation outweighs the need shown by the original reservant.

**PHASED EIS PROCESS**

The draft EIS and addendum were prepared to satisfy requirements under the Montana Water Use Act and the Montana Environmental Policy Act (MEPA). This addendum provides information for the Board to use in deciding whether it should grant, modify, or deny the GCD's Boulder Creek reservation request.

If the Board should grant the Boulder Creek reservation request,

it is possible that a second, more detailed EIS would be required prior to project development. DNRC's environmental analysis of GCD's proposed reservation is preliminary. Before beginning project construction, full geotechnical investigations would have to be conducted and sites identified from which fill material for the planned dam would be taken. Also, land would have to be acquired and final design and operating plans prepared before the dam could be built. The participation of state or federal agencies in the final development of the Boulder Creek project might require preparation of a second EIS.

Agencies that would have additional jurisdiction over project development if the proposed dam were to be constructed today are listed in Table 1-1. Depending on legislative changes and specific details concerning construction and operation, additional permits may be required.

## DESCRIPTION OF GCD'S BOULDER CREEK REQUEST

This section presents GCD's explanation, in summary, of why the reservation on Boulder Creek is needed, what amount of water is required, and why granting the reservation is in the public interest. DNRC's analysis of these questions is presented in Chapter Four.

GCD seeks a water reservation in Boulder Creek, a tributary of Flint Creek. The proposed 8,500 af reservoir in Boulder Creek would store -ater to irrigate 4,093 new acres (See Figure 1-1). The amount of water requested by GCD is 13,998 af per year. The maximum flow rate requested is 106.7 cubic feet per second (cfs). The reservoir would be used to store water year-round. Water would be delivered to project lands between May 1 and September 30.

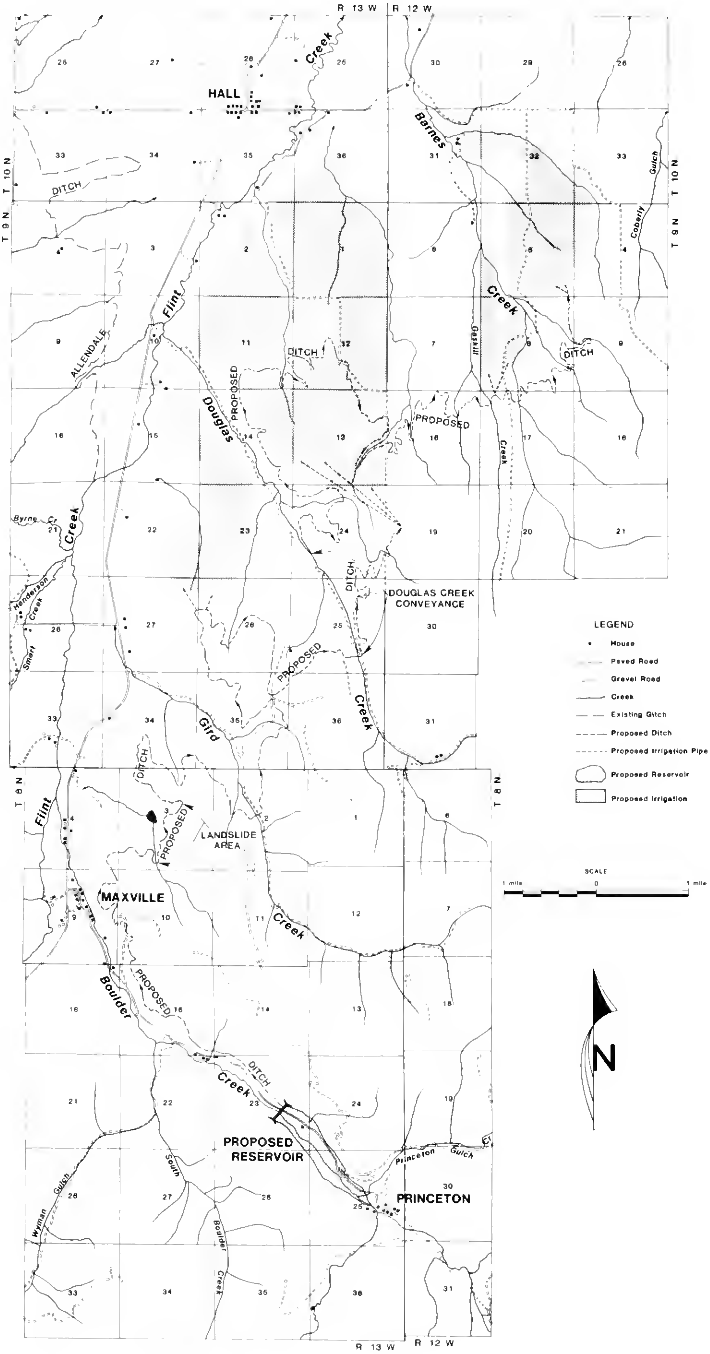
The reservoir would be located approximately 3 1/2 miles upstream of Maxville. The embankment would be about 145 feet high and 1,150 feet wide. The reservoir would inundate approximately 145 acres when full. The water would flow into a canal at the base of the dam and then follow the contour down Boulder Creek finally heading north above Maxville (see Figure 1-1). Siphons would be required to cross Gird, Douglas, and Barnes creeks. The canal would split when it crosses Douglas Creek. The main canal would empty into Douglas Creek (Southeast Quarter of Section 25, Township 9 North, Range 13 West). Water would be diverted back into a canal about one mile downstream (Southwest Quarter of Section 24, Township 9 North, Range 13 West). A smaller amount of water would pass through a siphon over Douglas Creek and empty into a smaller canal (Southeast Quarter of Section 25, Township 9 North, Range 13 West). There would be approximately 33 miles of canal in total. Turnouts would be placed in the canal to service the irrigated lands. At these turnouts, the water would flow into pipelines and eventually to wheelline irrigation systems. The unique feature of the design is that the pressure in the system would be generated from gravity and no pumps would be necessary.

Table 1-1. Agencies with Possible Jurisdiction

| | |
|---|---|
| BPA | Review of easement concerns and access |
| DFWP | Endangered and threatened species |
| DHES | Water quality and air quality permits |
| DNRC | Dam safety construction permit |
| DSL | Hazard Reduction permit, BMP notification |
| FERC | Possible subordination of hydropower licenses |
| GCD | 310 permit |
| State Historic Preservation Office | Cultural and Historic Resources Survey |
| U.S. Army Corps of Engineers | 404 water quality permit |
| U.S. Bureau of Reclamation | Small project loan program |
| USFS | Special use permit |

**FIGURE 1-1.**

**PROPOSED BOULDER CREEK RESERVOIR, CANAL, AND IRRIGATED LANDS**



## Need

GCD is applying for a reservation to ensure water will be available for the proposed project on Boulder Creek. The applicant notes that the proposed project cannot be built under present economic conditions. When the economy becomes stronger, GCD would use the water that it seeks to reserve. If the reservation is not granted, GCD contends that unappropriated water may not be available for two reasons:

1. "Water in the Clark Fork drainage is presently over appropriated for most of the year" (GCD 1987).

2. "The Department of Fish, Wildlife and Parks is requesting instream flow reservations on Flint Creek and Boulder Creek. Both of these instream flow requests could limit development in the basin" (GCD 1987).

DNRC's analysis of need for this project is presented in Chapter Four.

## Amount

GCD estimated the total annual water demand for the project to be 14,812 af. Of this amount, 814 af will serve 238 acres of land currently irrigated under water rights for Boulder Creek water (the 238 acres are reported in Water Resources Survey: Granite County, Montana (Montana State Engineer's Office 1959)). Therefore, GCD's reservation request totals 13,998 af (14,812 af minus 814 af).

GCD is concerned that the amount of water applied for might not be legally available. Objections to the pending water reservation applications may be filed by anyone whose property, water rights, or interests may be adversely affected by the proposed reservation. In particular, holders of existing irrigation claims and permits in the Boulder Creek and Flint Creek drainages might object to GCD's requested reservation. GCD is also concerned that "large hydropower water rights...could limit water storage for the project" (GCD 1987). To date, Washington Water Power (WWP) and the Montana Power Company (MPC) have not objected to the issuance of any new water-use permits and have not curtailed water use by junior appropriators. A contested case hearing will be held to resolve any objections. GCD lists four strategies to overcome constraints to water availability that might be posed by the water right claims and permits of downstream hydroelectric facilities (GCD 1987).

1. Obtain federal sponsorship or funding of the proposed Boulder Creek project in order to subordinate the downstream hydropower rights to the proposed GCD use. The federal licenses for the downstream hydroelectric projects already contain certain conditions which allow for their subordination to future upstream federal water resource development.

2. Negotiate an exchange of water rights among WWP, MPC, and the Bureau of Reclamation. Hungry Horse Reservoir is a Bureau of

Reclamation project that was established for multiple purposes which include irrigation.

3. Attempt to subordinate the WWP and MPC projects to future upstream developments by inclusion of such terms in the licenses for these projects, when they come up for relicensing by the Federal Energy Regulatory Commission (FERC). MPC has asked FERC to extend its license at Milltown to the year 2015. The current license will expire in 1993. The license for Thompson Falls expires in 2015. Relicensing of WWP's Noxon Rapids Dam is not scheduled until the year 2005. FERC may also consider GCD's request for subordination if and when construction of the Boulder Creek project begins (FERC 1988).

4. Subordinate hydropower uses to upstream developments via state legislation. This would require an amendment to the Federal Power Act to give the state this authority.

In its application, GCD is optimistic that one of these strategies will ensure water availability in the Clark Fork basin. DNRC's analysis of these strategies and other water right issues is presented in Chapter Three.

Public Interest

To fulfill the requirement that the reservation must be in the public interest, GCD estimated project costs and benefits and briefly discussed indirect costs and benefits. GCD estimated the total project costs to be $12,592,000 plus $76,300 per year in operation and maintenance. This is equivalent to an annual cost of $796,400 (assuming a 5 percent discount rate and a 50-year project life). This cost estimate includes dam costs, canal costs, and on-farm system costs. GCD estimates that project benefits (net of farm production costs) will average $163.68 per acre or $708,900 per year ($163.68 x 4,331 acres) for the entire project (see Appendix B). While the applicant admits that project costs exceed benefits, GCD is hopeful that federal or state funding can be obtained to make the project feasible at the local level.

According to GCD, the project would provide indirect economic benefits by increasing spending in the local economy. Unquantified benefits include improved fishing opportunities at the reservoir site, increased wildlife habitat along the canal, stream flow maintenance during low-flow periods, decreased streambed degradation during high-flow periods, and decreased erosion on project lands (GCD 1987). Unquantified project costs that were considered by GCD include decreased fisheries below the proposed reservoir, decreased dilution of pollutants in the Clark Fork, inundation of wildlife habitat, decreases in water quality, and visual or aesthetic quality degradation due to borrow

pits, canals, and reservoir facilities (GCD 1987). GCD estimates that the indirect benefits would be greater than the indirect costs.

DNRC's analysis of public interest is presented in Chapter Four.

**DFWP'S INSTREAM FLOW REQUESTS AND GCD'S NORTH FORK OF LOWER WILLOW CREEK RESERVATION REQUEST**

The draft EIS (DNRC 1988) analyzed the impact of granting, granting in part, or denying DFWP's instream flow requests on the Clark Fork main stem and 17 tributaries and GCD's North Fork of Lower Willow Creek request. Copies of the draft EIS are still available from DNRC. A short summary of these requests is presented below.

<u>DFWP's Instream Flow Requests</u>

DFWP's requests are summarized in Table 1-2. Figure 1-2 shows the location of the streams where reservations are being requested. An instream flow reservation would retain water in the stream after senior water rights are satisfied. DFWP's two primary objectives are to provide year-round protection of aquatic habitat, and to maintain tributary flows from January 1 to April 30 to dilute pollutants in the Clark Fork main stem. DFWP acknowledges that winter-time dilution flows won't be needed if the ongoing clean-up is successful and metals concentrations reach acceptable levels. Accordingly, DFWP's reservation on Boulder and Flint Creeks would be reduced to the amount of water granted year-round to maintain aquatic habitat and recreational resources.

DFWP's request in Boulder Creek is for 20 cfs year-round (14,479 af/year). The instream flow request is for the entire length of Boulder Creek from its headwaters to the mouth (13.4 miles). In its application, DFWP states that "the requested flow is necessary to maintain the integrity of the existing, (but declining) native westslope cutthroat and bull trout populations; to provide good quality water to Flint Creek and, in turn, to the Clark Fork River for dilution of mining pollutants; and to help protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water and shelter" (DFWP 1986).

DFWP's request in Flint Creek, below Boulder Creek, is for 45 cfs year-round (32,578 af/year). DFWP states that the "requested flow is necessary to maintain the existing resident trout populations and to help protect the stream from future water withdrawals which would contribute to an already severe problem in the low section of the reach; and to help protect the habitat of those wildlife species present which depend on the stream and its riparian zone for food, water and shelter" (DFWP 1986).

<u>GCD's North Fork of Lower Willow Creek Request</u>

In addition to the Boulder Creek request, GCD has requested a water reservation on the North Fork of Lower Willow Creek, a tributary of Flint Creek. The amount requested for this project

is 11,165 af. The project would provide supplemental water to 2,900 acres that currently receive water from the existing Lower Willow Creek reservoir. The existing and proposed reservoirs, irrigated lands, and canal system are shown in Figure 1-3.

# Table 1-2. DFWP's Reservation Requests[a] .

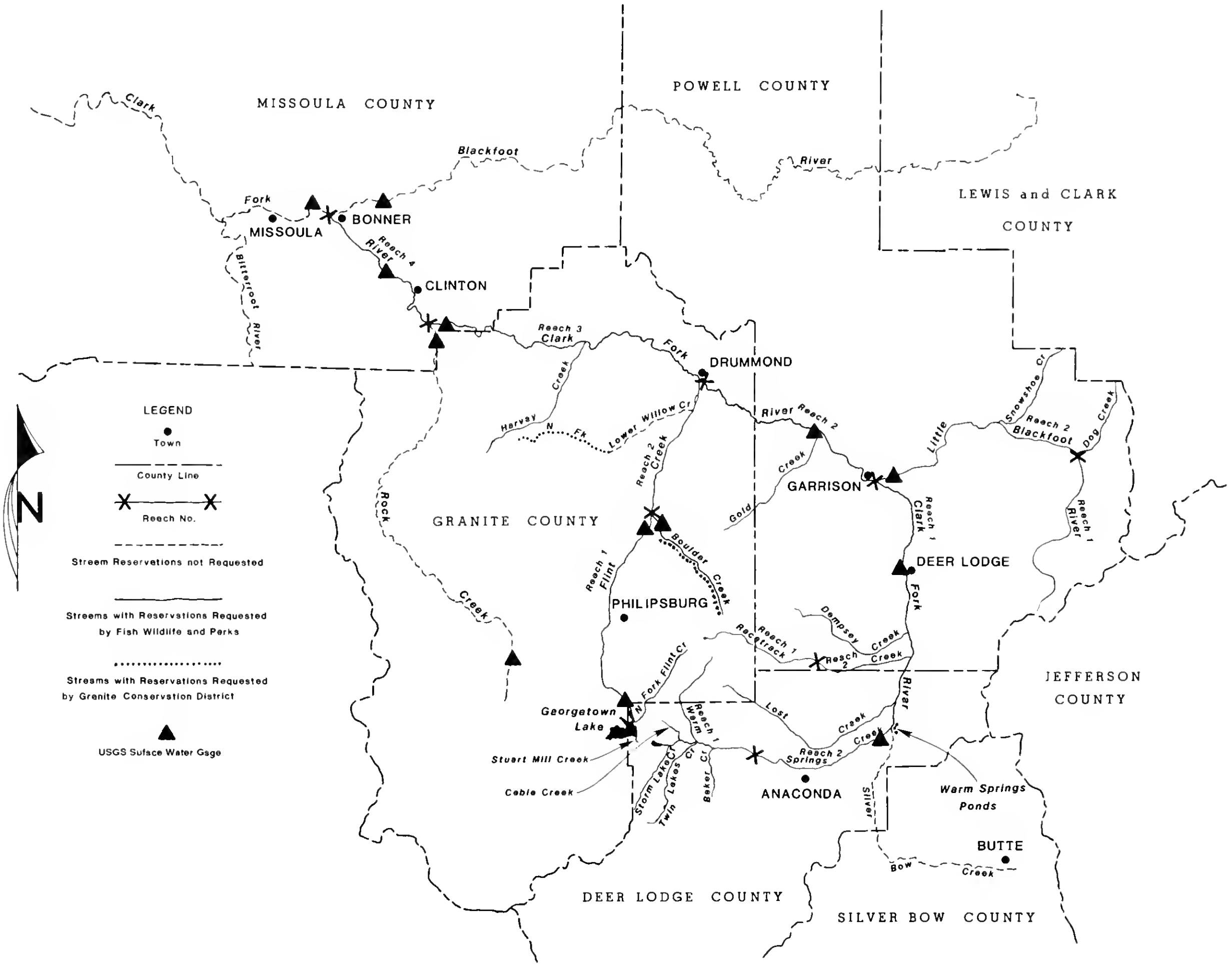
| Stream Name | Length of Stream Reach (Miles) | Flows and Volume of Water Requested Year Round | Instream Flows for Water Quality Jan. 1 to April 30 |
|---|---|---|---|
| **MAIN STEM** | | | |
| Clark Fork main stem | | | |
| Reach 1<br>(Warm Springs Creek - Little Blackfoot River) | 37.8 | 180 cfs<br>130,314 af | none |
| Reach 2<br>(Little Blackfoot River - Flint Creek) | 28.1 | 400 cfs<br>289,587 af | none |
| Reach 3<br>(Flint Creek - Rock Creek) | 35.8 | 500 cfs<br>361,983 af | none |
| Reach 4<br>(Rock Creek - Milltown) | 17.2 | 600 cfs<br>434,380 af | none |
| **TRIBUTARIES** | | | |
| Warm Springs Creek | | | |
| Reach 1<br>(Confluence of Middle Fork Warm Springs Creek - Meyers Dam) | 15.3 | 50 cfs<br>36,198 af | |
| Reach 2<br>(Meyers Dam - Mouth) | 16.6 | 40 cfs<br>28,959 af | |
| Barker Creek | 5.1 | 12 cfs<br>8,688 af | |
| Cable Creek | 5.8 | 10 cfs<br>7,240 af | |
| Storm Lake Creek[b] | 10.0 | 10 cfs<br>7,240 af<br>3 cfs<br>2,172 af | |
| Twin Lakes Creek | 7.5 | 13 cfs<br>9,412 af | |
| Lost Creek | 19.9 | 16 cfs<br>11,583 af | |
| Racetrack Creek | | | |
| Reach 1<br>(Confluence of North Fork Racetrack Creek-USFS Boundary) | 9.3 | 26 cfs<br>18,823 af | All of the instantaneous base flow, subject to existing, lawfully appropriated water rights until such time as mine waste reclamation allows copper concentrations entering the Clark Fork above Warm Springs Creek to reach acceptable levels in downstream reaches. Flow is requested at each stream's confluence with the Clark Fork. |
| Reach 2<br>(USFS Boundary - mouth) | 10.8 | 3 cfs<br>2,172 af | |
| Dempsey Creek | 17.1 | 3.5 cfs<br>2,543 af | |
| Little Blackfoot River | | | |
| Reach 1<br>(Blackfoot Meadows - Dog Creek) | 17.4 | 17 cfs<br>12,307 af | |
| Reach 2<br>(Dog Creek - mouth) | 26.9 | 85 cfs<br>61,537 af | |
| Snowshoe Creek | 9.2 | 9 cfs<br>6,516 af | |
| Dog Creek | 15.5 | 12 cfs<br>8,688 af | |
| Gold Creek | 15.0 | 34 cfs<br>24,615 af | |
| Flint Creek | | | |
| Reach 1<br>(Georgetown Lake - Boulder Creek) | 28.0 | 50 cfs<br>36,198 af | |
| Reach 2<br>(Boulder Creek - mouth) | 15.7 | 45 cfs<br>32,578 af | |
| Boulder Creek | 13.4 | 20 cfs<br>14,479 af | |
| North Fork of Flint Creek | 7.5 | 6 cfs<br>4,344 af | |
| Stuart Mill Creek | .3 | 14 cfs<br>10,136 af | |
| Harvey Creek | 14.6 | 3 cfs<br>2,172 af | |

[a]In addition, DFWP already has claimed rights on Rock Creek and the Blackfoot River

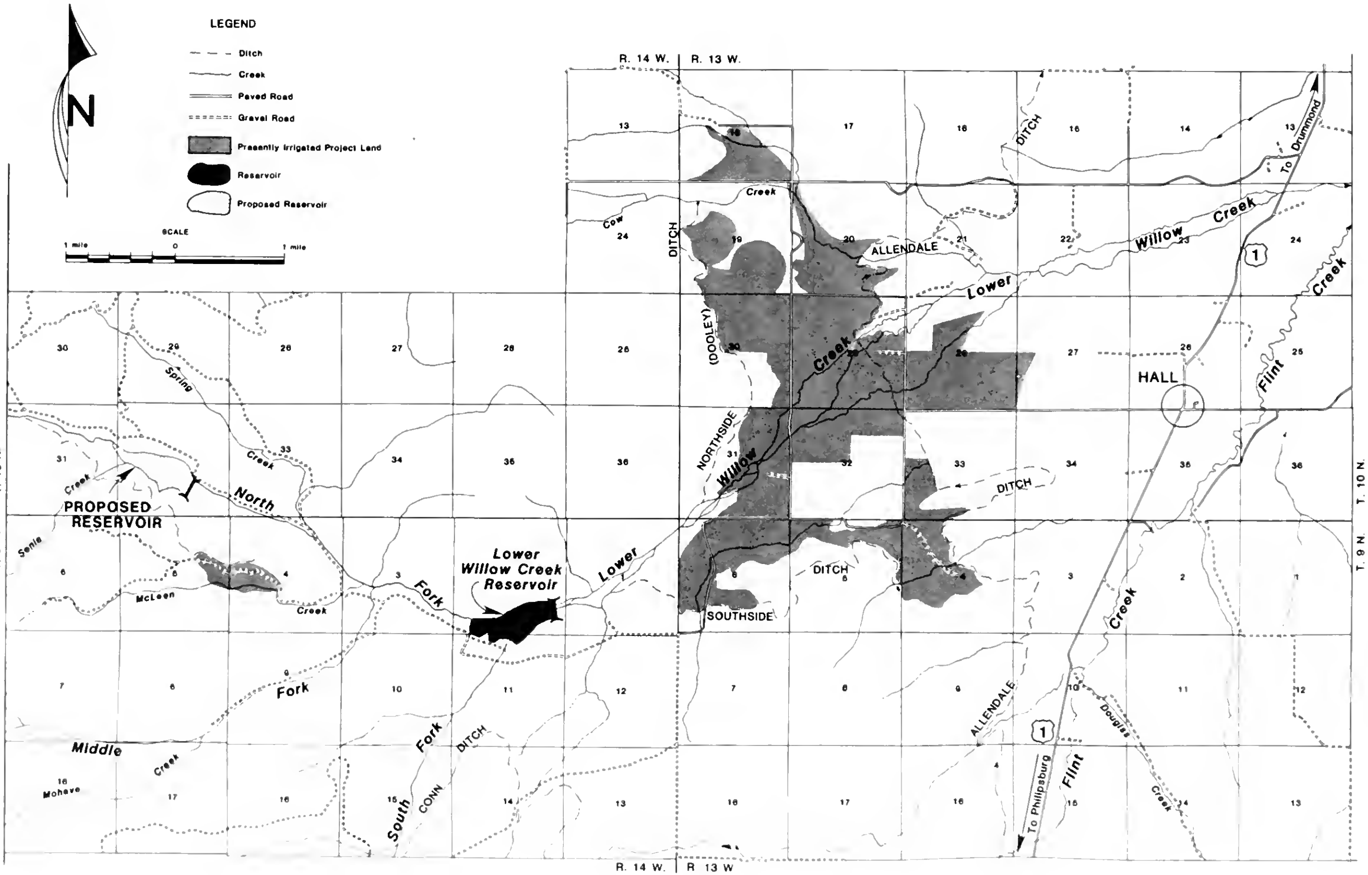
[b]10 cfs is requested if diversions to Storm Lake do not occur at their usual level. If diversions are resumed at their past levels, the flow request is 3 cfs

# FIGURE 1-2

# RESERVATION REQUESTS IN THE UPPER CLARK FORK BASIN



# FIGURE 1-3
# LOWER WILLOW CREEK PROJECT AREA



# CHAPTER TWO
# EXISTING ENVIRONMENT

This chapter describes the environmental resources of Boulder Creek, Flint Creek, and the Clark Fork main stem that could be affected by the proposed reservation. This discussion is intended to portray these environmental resources as they exist today. Chapter Three discusses the impacts of the proposed project on these resources.

## WATER QUANTITY

The availability of water for beneficial use is governed by an interplay of natural and legal factors. On a yearly basis, natural factors such as the amount of snowmelt or the frequency of rainfall can vary widely and unpredictably. Legal factors--the complex array of water rights that govern water use--also change from year to year with the issuance of new water use permits and changes in existing rights. The interaction of these natural and legal factors gives rise to uncertainties over the availability of water in the Clark Fork basin for future needs. In particular, there is a question as to whether or not existing water rights would limit the amount of water available to future water users. A more detailed discussion of these uncertainties is presented in this section under the heading, "Legal Water Availability."

### Hydrology

Boulder Creek flows have been measured by the U.S. Geological Survey (USGS) since 1939. The Boulder Creek gauge (USGS Gage # 12330000) is located 0.2 miles upstream from the confluence of Boulder Creek and Flint Creek. A USGS gauge (USGS Gage # 1239500) on Flint Creek is located approximately 1 mile upstream of Boulder Creek. Flint Creek has been measured at this location since 1941. These gauges provide useful information about the amount of water that originates in Boulder Creek and its relative contribution to Flint Creek below the confluence. There are gauging stations on the Clark Fork main stem above and below its confluence with Flint Creek (USGS Gage #'s 12324680 and 12331900 respectively). Flow records from these stations are useful for determining the contribution of Boulder and Flint creeks to the Clark Fork main stem (USDI 1988b). The locations of these gauging stations, as well as others, are shown in Figure 1-2.

The average flow of Boulder Creek for the 48-year period of record is 47.9 cfs. The average volume of water discharged from Boulder Creek is 34,700 af per year. This compares to an average flow of 102 cfs and a discharge of 73,900 af per year for Flint Creek above Boulder Creek. At the confluence, Boulder Creek contributes approximately 32 percent of the combined flow of these two streams, on average (USDI 1988b). Figures 2-1 through 2-6 show flows on average, flows exceeded in 8 years out of ten (80%), flows exceeded 5 years out of 10 (50%), and flows exceeded in

2 years out of 10 (20%) for selected locations. These flows represent mean monthly flows and were developed using DNRC hydrologic models. Flow records for these six locations as well as seven additional sites on the Clark Fork main stem are presented in Appendix A.

The average flow of the Clark Fork main stem above its confluence with Flint Creek is 628 cfs (USGS Gage # 12324680 located at Gold Creek). The average volume of water passing this point is 455,000 af. The average flow of the Clark Fork main stem below its confluence with Flint Creek is 935 cfs. The average annual discharge at this point, just above Rock Creek, is 677,400 af (USGS Gage #12331900) (USDI 1988b).

Figure 2-1

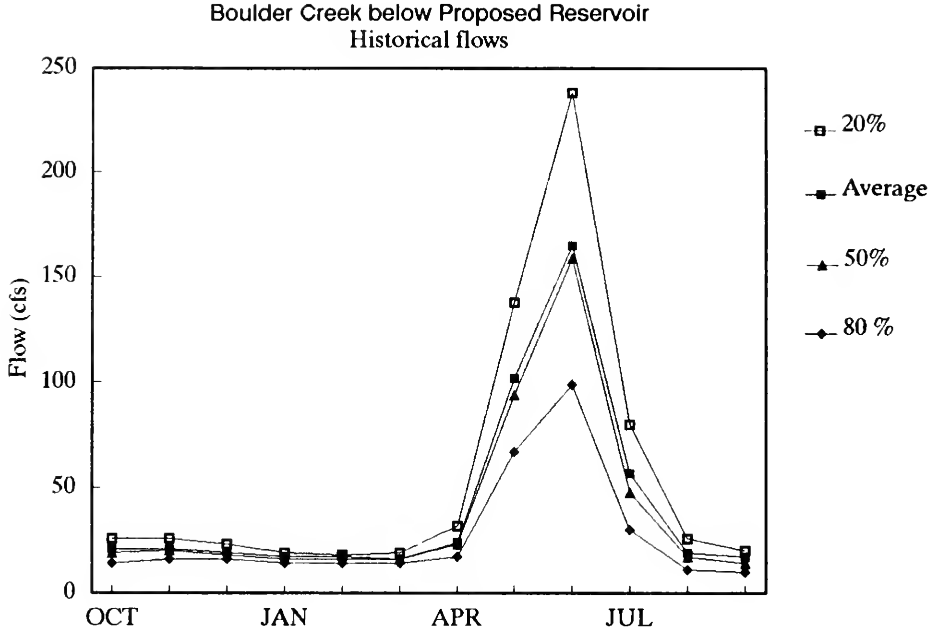



Figure 2-2

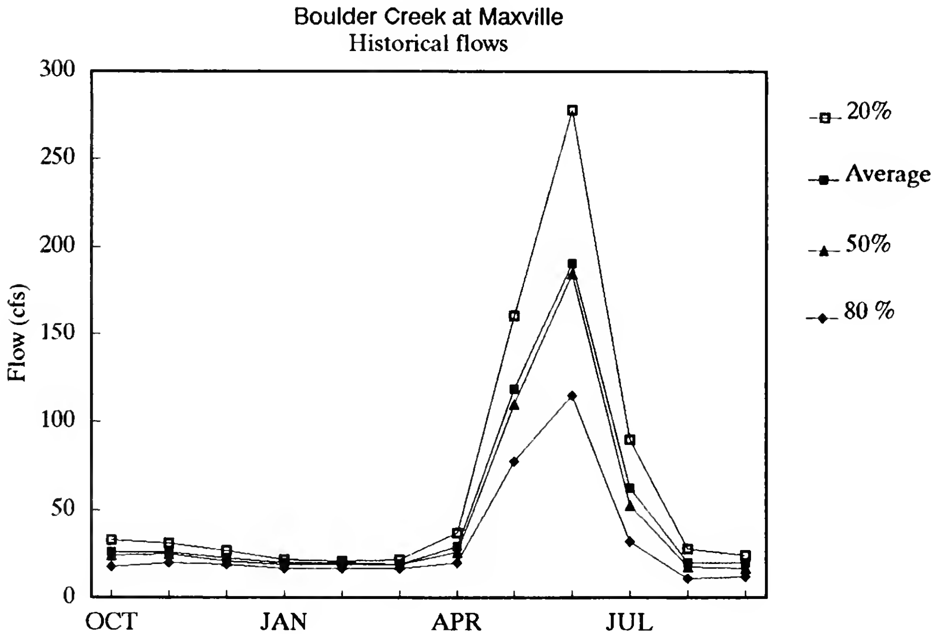


Figure 2-3

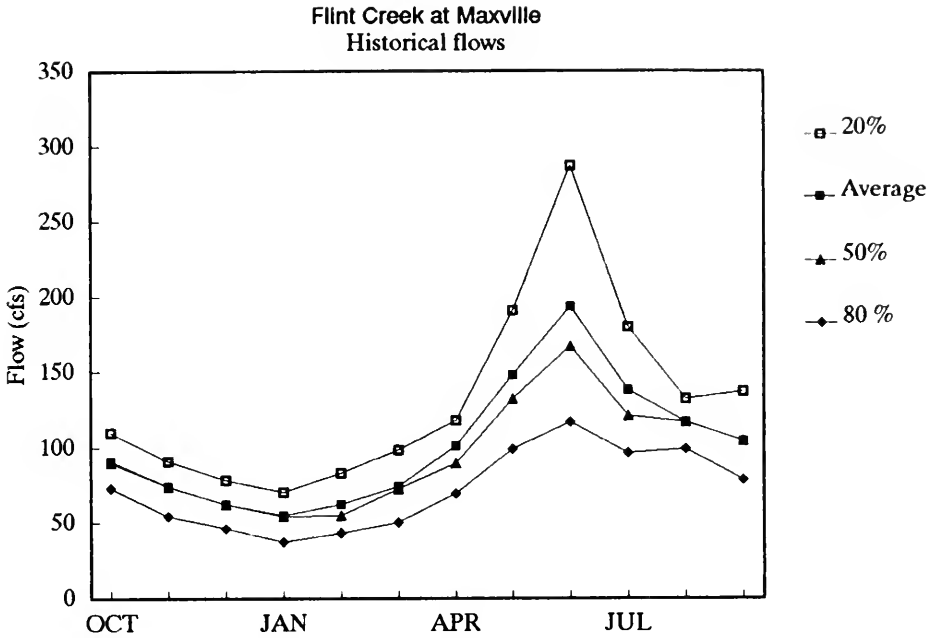



Figure 2-4

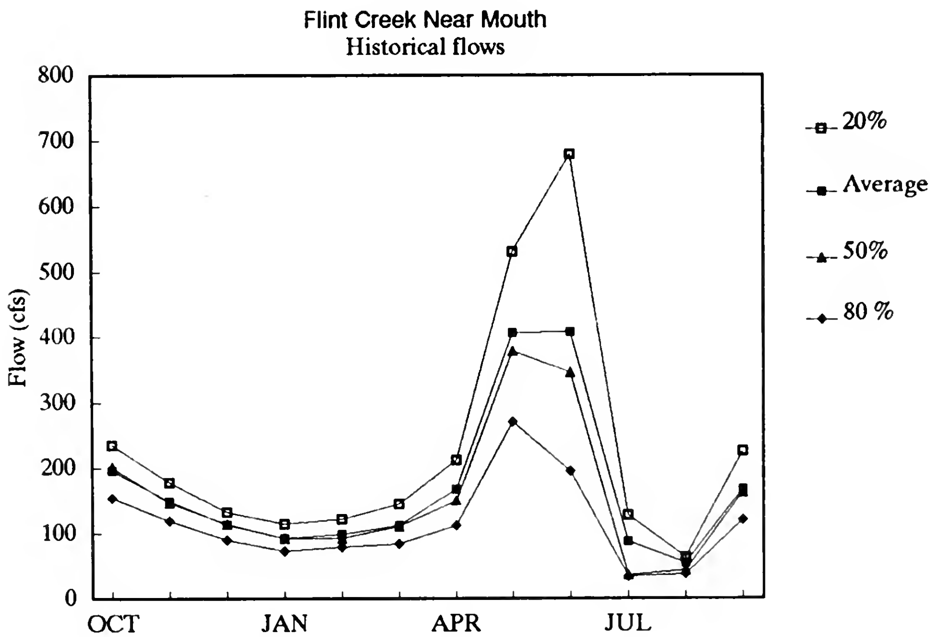


Figure 2-5

Clark Fork below Confluence with Gold Creek
Historical flows

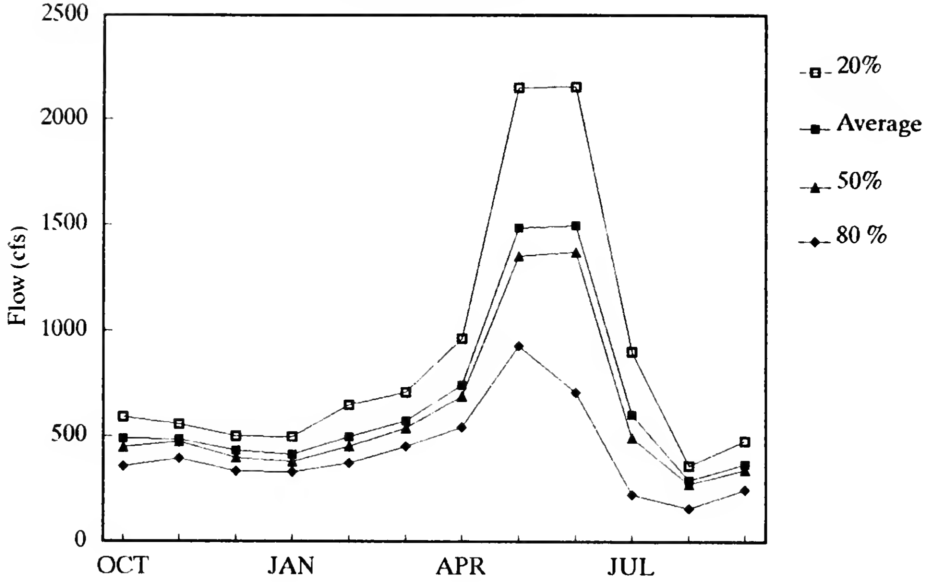
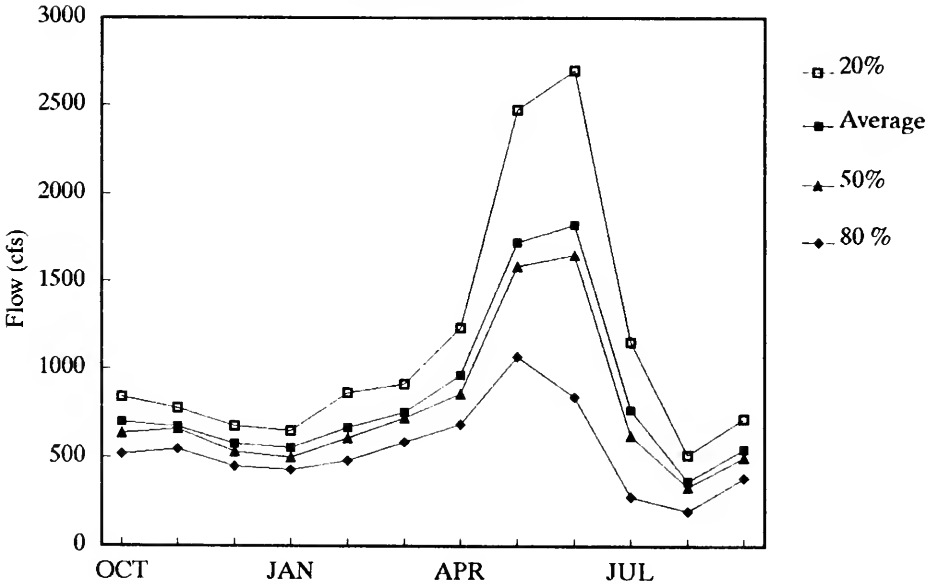



Figure 2-6

Clark Fork below Confluence with Flint Creek
Historical flows



## Water Rights

DNRC water right records show that there are 34 claimed water rights and one permit on Boulder Creek. Of these, 15 are for irrigation on a total of 710 acres. The largest irrigation diversion is for 12.5 cfs and 999 af/year to irrigate 227 acres. The total volume of Boulder Creek water claimed for irrigation is 3,484 af/year. All of the irrigation water rights have a priority date before 1900; the earliest is 1864.

The largest single water right on Boulder Creek is for 7,382 af/year and 10.22 cfs. The claimed use of this water is for hydropower generation. This same water was also diverted for mining uses under a separate claim. The facilities associated with these rights are no longer in operation, but still have water right claims. The one permit issued on Boulder Creek, which has an April 1982 priority date, is for mining. The permit is for a 0.22 cfs diversion and a total volume of 24 af/year. There are also 11 water rights for stockwater and 1 right for domestic use. All of the stockwater water rights have a priority date before 1900. The domestic use dates from June 1890.

In Flint Creek, below Boulder Creek, there is a total of 125 water right claims and permits. Irrigation use is associated with nearly all of these rights. The largest single irrigation right is held by DNRC for a 157 cfs diversion into the Allendale Canal. This right has a priority date of March 1936. All but seven of the irrigation rights have priority dates established before 1900. There are two permits issued in Flint Creek; both are for supplemental irrigation and were issued in 1984. The total volume of water claimed and permitted is 60,044 af/year. The total amount of irrigated land along Flint Creek below Boulder Creek, based on water right records, is 14,206 acres. All of the remaining rights are for stockwater use.

On the Clark Fork main stem downstream of Flint Creek, the largest claimed and existing water rights that could limit future water uses in the Flint Creek basin are those filed by the MPC and WWP for hydropower generation. MPC's Milltown dam is located just upstream of Missoula. The dam has the capacity to generate 3.2 megawatts and has a claimed right of 2,000 cfs with a priority date of December 1904. The next downstream hydropower dam is MPC's Thompson Falls facility. This dam has the capacity to generate 40 megawatts and has a claimed right of 11,120 cfs dating from 1905 (see Figures 2-7 and 2-8 for a comparison of these water right claims to historical flows).

The furthest downstream hydropower dam on the Clark Fork in Montana is WWP's Noxon Rapids facility. This dam has the largest generating capacity, 554 megawatts, and the largest single appropriation in the entire Clark Fork basin, 50,000 cfs. WWP has two claims filed. The first claim is for 35,000 cfs and was filed in 1951; the second is for 5,400 cfs and was filed in 1959. However, the turbines at Noxon Rapids can handle an additional 9,600 cfs, and in 1974 WWP was issued a water use permit for increased hydropower generation not to exceed 50,000 cfs (see Figure 2-9

for a comparison of these water right claims and permit to historical flows).

Figure 2-7

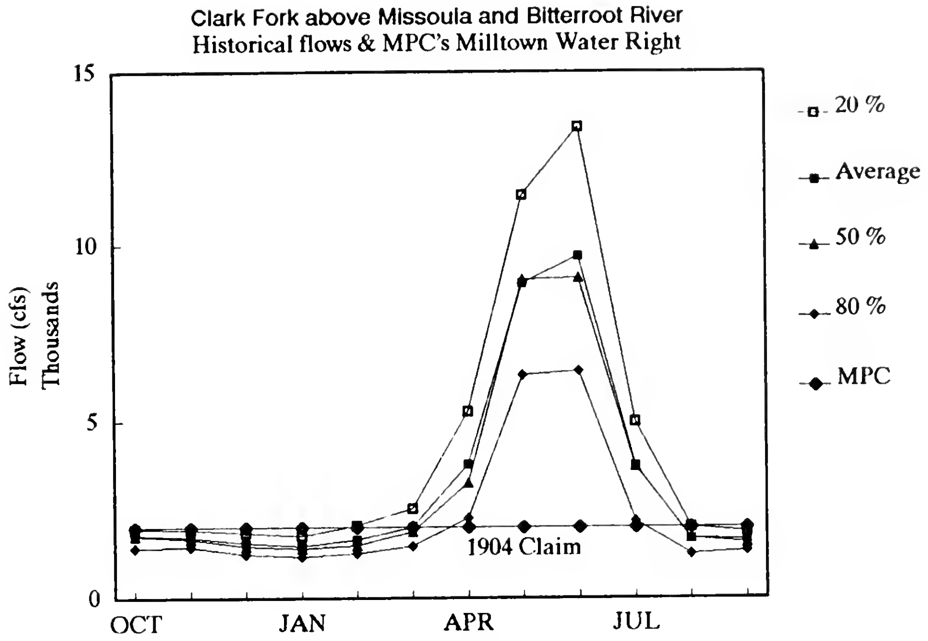



Figure 2-8

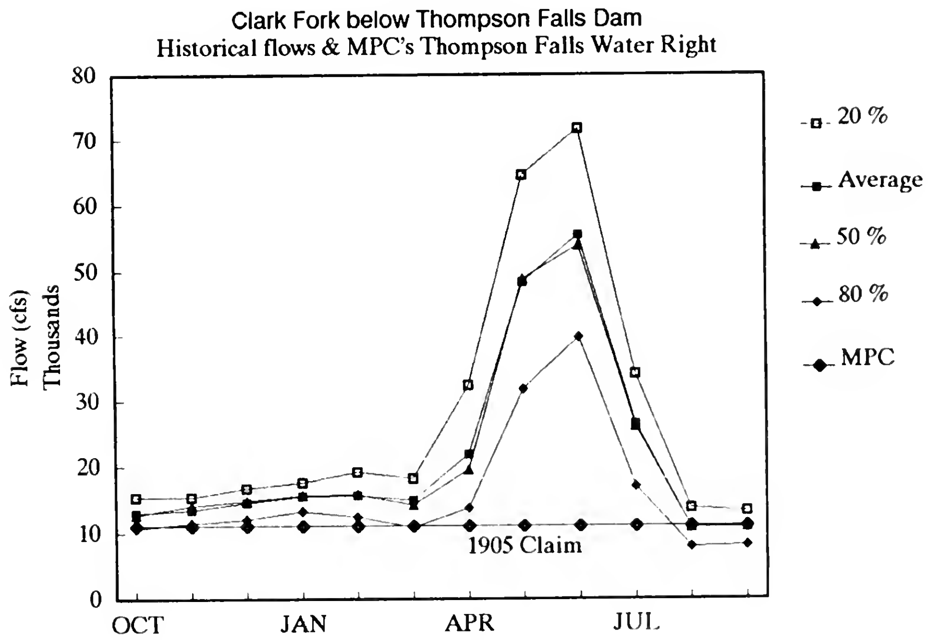
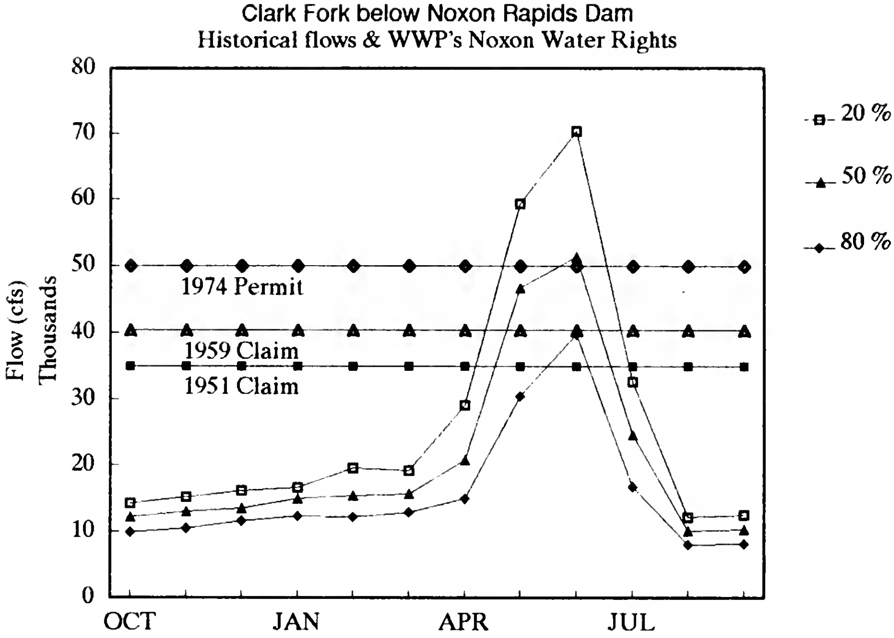


Figure 2-9



Clark Fork below Noxon Rapids Dam
Historical flows & WWP's Noxon Water Rights
80
70
60
50
40
30
20
10
0
Flow (cfs)
Thousands
1974 Permit
1959 Claim
1951 Claim
OCT
JAN
APR
JUL
20 %
50 %
80 %

The water court has not yet issued a final decree concerning water right claims in the Clark Fork basin. At present, claims filed in the Clark Fork basin must be considered as valid, but the amount of water claimed may be changed during the final adjudication. If the amount of water decreed in the adjudication process is less than the amount claimed, there may be more unappropriated water available for future use than currently projected.

The first step in the adjudication process in the Flint Creek basin (76GJ) is nearly complete. According to the Montana Water Court, a temporary, preliminary decree has been issued and approximately 75 percent of the objections are resolved. By early next year the remaining 25 percent should be completed (Lambert 1989). After this process is completed, the water rights identified in the temporary, preliminary decree will be enforceable (85-2-231(6)MCA).

The preliminary and final decrees cannot be issued until all federal and Indian reserved water rights are quantified. Claims have been made in the basin by the United States Department of Agriculture for water flowing through the national forests. Also, on behalf of the Confederated Salish and Kootenai Tribes of the Flathead Reservation, the Bureau of Indian Affairs has filed a claim in the Clark Fork basin for instream flows to protect aboriginal rights recognized by treaty. The nature and extent of water rights for these purposes will be determined within the state adjudication, either through negotiations with the Montana Reserved Water Rights Compact Commission or through the water court.

Objections to the pending water reservation applications may be filed by anyone whose property, water rights, or interests may be adversely affected by the proposed reservation. GCD's reservation applications for Boulder Creek and the North Fork of Lower Willow Creek and DFWP's instream flow application will be publicly noticed once the final EIS is published. A contested case hearing will be held to resolve these objections. However, even if existing water right holders don't object, they will still have senior rights, and the potential exists that sometime in the future these rights could limit water use for these reservations.

**WATER QUALITY**

Boulder Creek, Flint Creek, and the Clark Fork main stem below Flint Creek are classified as B-1 streams by the Montana Board of Health and Environmental Sciences (BHES)(16.20.604(1)ARM). The B-1 standard is summarized in below.

> B-1 waters are suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. Slight increases in turbidity and color are allowed without a permit. Dissolved oxygen concentrations must not be decreased below 7.0 mg/l.

Concentrations of toxic or deleterious substances may not exceed levels set forth in EPA's Quality Criteria for Water 1986, the "Gold Book", (U.S. EPA 1986) and Update# 2 (U.S. EPA 1987)(16.20.618 ARM).

Although extensive mining took place in the upper reaches of Boulder Creek and its tributaries, this creek has very high water quality as indicated by a DHES study (1979). Zinc in the total recoverable form was found at concentrations of 0.01 mg/l in the 1979 DHES study, but it did not seem to adversely affect aquatic insects. According to DHES, "aquatic insects were nonetheless extremely abundant and diverse perhaps due to the hardness of the water buffering any toxic effects." Diverse and abundant populations of aquatic insects indicate that pollution levels are low. The periphyton community (algae that live on and attach to the bottom) also "indicated cool, well oxygenated, unpolluted waters" (DHES 1979).

Water quality is generally good in Flint Creek. One exception is arsenic, a demonstrated carcinogen causing both skin and internal cancers (Horpestad 1990; U.S. EPA 1988). In the upper Clark Fork, including Flint Creek and its tributaries, arsenic levels exceed the BHES surface water quality standard of 0.00002 mg/l (20 nanograms/liter) (DHES 1979, 1987, 1989a, 1989b; USDI 1986, 1987, 1988). Appendix D presents water quality data for Flint Creek.

## FISHERIES

Boulder Creek is rated as a Class-3 (substantial) fishery (DFWP 1987b). Westslope cutthroat trout are common. Visual inspection indicates that these are pure strain westslope cutthroat trout, but this has not been verified; hybrid strains have been planted in the creek (DFWP 1987b). Brook trout are also common. Bull trout, rated as a species of special concern by the Montana Natural Heritage Program (1989), are present above Princeton and above the confluence of Flint Creek. Bull trout are reported to ascend Boulder Creek to spawn, but this has not been confirmed (DFWP 1986). Brown trout are also present in the lower portion of Boulder Creek. Table C-1, page 145 in the draft EIS, identifies fish species that are present in Flint Creek.

## RECREATION

Most tributary streams of the upper Clark Fork receive some fishing use and typically contain good to excellent fisheries. The main stem receives approximately 17,500 visits per year and tributaries receive approximately 24,000 (DFWP 1987a). This does not include recreational use on Rock Creek and the Blackfoot River.

Recreational use on three Clark Fork tributaries - Flint Creek, Warm Springs Creek, and Little Blackfoot River - was observed by Hagmann (1979). Recreational use along Flint Creek was estimated at 11,948 visits per summer (plus or minus 19 percent). Seventy percent of this use, or 8,364 visits, occurred at the U.S.

Forest Service's Flint Creek campground near Georgetown Lake. Another 16 percent, or 1,912 visits, was distributed along Flint Creek.

Streams in the area provide opportunities for fishing, and the reservoirs at Georgetown Lake, on the East Fork of Rock Creek, and on the North Fork of Lower Willow Creek provide both shoreline and boat fishing (DNRC 1988). Other shoreline activities also are available at these reservoirs. Use estimates for fishing pressure on area streams and reservoirs are presented in Table 2-1.

Table 2-1. Fishing Pressure Estimates

| Water Body | Angler days per yr | N[a] |
|---|---|---|
| Douglas Creek | 557 | 1 |
| Lower Willow Creek | 346 | 1 |
| Upper Willow Creek | 410 | 1 |
| Boulder Creek | 938 | 3 |
| Flint Creek | 4,382 | 4 |
| East Fork Reservoir | 4,334 | 4 |
| Georgetown Lake | 44,499 | 4 |

[a]N = number of years with reported data
Source: DFWP 1989

The county road through the Boulder Creek drainage provides easy recreational access to land in the upper drainage. National forest land in the Boulder Creek drainage receives heavy dispersed recreational use in the all for hunting and to a lesser degree in the summer for backpacking, camping, picnicking, fishing, and motor biking (Paterni 1987). The site of the proposed Boulder Creek Dam is on private property.

**VEGETATION AND WILDLIFE**

Boulder Creek flows through timbered mountains and is used by beaver and mink. Mountain grouse are associated with riparian habitats as are mule deer, elk, and moose in the upper reaches and white-tailed deer in the lower reaches (DFWP 1986). Boulder Creek, a fast flowing, mountain stream, exhibits the required habitat conditions for tailed frogs, a species listed by the Montana Natural Heritage Program (1989) as rare in Montana. Tailed frogs have been reported in the upper Clark Fork basin, but no one has searched for the frogs in Boulder Creek (Genter 1990).

North aspects of the reservoir site are dominated by Douglas-fir and ninebark; Douglas-fir and lodgepole pine cover the south aspects. Gentle slopes near the stream support sedge-dominated meadows and stands of willows. Beaver and mule deer move through the area, and the local bird population appears to be particularly diverse (Murphy 1987). Moose may currently use the proposed reservoir site for winter range (Nielson 1987).

The route for the proposed canal has not been surveyed for plants or animals. The irrigation sites are primarily grassland with introduced grasses dominating many areas. Mule deer winter on the eastern portions of the sites (McCleerey 1987).

## LAND USE

The proposed location of the Boulder Creek reservoir lies adjacent to the townsite of Princeton. Several year-round residents live on old patented mining claims, and several summer homes are located in the area. The reservoir site itself is on private land that is rocky and covered with pine and fir trees. Downstream at Maxville, several houses lie within the Boulder Creek floodplain (FEMA 1982).

The county road up the bottom of the Boulder Creek valley is the sole access to the townsite. This road also is used as a route into BPA's 500-kv transmission line. The road provides access into the Deerlodge National Forest road system and is planned for use on timber sale activity in the coming years (Learn 1990).

The irrigated lands would be located several miles north of the reservoir site along the benchland east of Flint Creek (Figure 1-1). The area currently is primarily used as rangeland with some irrigated lands served by diversions from Douglas Creek. The proposed canal route would cross private, U.S. Forest Service, and state lands.

Existing diversions from Boulder Creek are carried by the Hannah, Ledbetter, and Wickburg-Norris ditches to irrigate land in the Flint Creek valley. The Water Resources Survey -- Granite County, Montana (Montana State Engineer's Office 1959) indicates a total of 238 acres are irrigated with water from Boulder Creek. These lands were considered in GCD's reservoir operation analysis included in its application (GCD 1987). However, water right records indicate that a total of 710 irrigated acres, including the 238 acres, have claimed rights for Boulder Creek water.

## EARTH RESOURCES

### Geology

The project area is located on the northwest flank of the Flint Creek Range. The bedrock geology of the area consists of sediments over 500 million years old that were folded and thrust faulted. Deformation was also caused by volcanic intrusions (McGill 1959). Folded sedimentary beds are truncated over the northern portion of the project area by gravel-veneered terraces of Miocene and Pliocene age. Pleistocene glaciation and recent stream erosion have cut the landscape into steep-walled drainages. Total relief within the project area is approximately 1,160 feet from the upstream margin of the reservoir near Princeton, to the edge of the proposed irrigated land near Flint Creek.

### Soils

The influences of topography, climate, and parent material have formed a variety of soils within the project area. The soils on the Boulder Creek drainage bottom are well-drained to poorly-drained sands and loams with large amounts of gravel, cobbles, and boulders. Soils along the east-facing slope of the Douglas Creek drainage are well-drained, shallow to moderately deep loams formed in colluvium on 20 to 60 percent

slopes (Ruppert 1980).

The proposed canal route crosses the surface of old landslides in Section 3, Township 8 North, Range 13 West. Hummocky topography, tilting trees, and ponded drainage indicate surface instability. Soils on the slide surface are deep, well-drained and somewhat poorly-drained loams and clay loams. The Tertiary terrace landscapes have well-drained and excessively drained, gravelly and cobbly loam and sandy loam soils on warm, southerly exposures, with deeper loams and clay loams on cooler slopes.

Soils within the proposed irrigated area are predominantly deep and moderately deep loams and clay loams with varying amounts of gravel and cobbles. Slopes range generally from 0 to 8 percent. The dominant series include the Rothiemay, Anaconda, Tanna, Roundley, Coben, Judith, Danvers, and Perma soils (Long 1989).

## SOCIOECONOMIC CONDITIONS

Granite County's 1988 population was estimated to be 2,600 (U.S. Department of Commerce 1989a). The county's population experienced little change during the 1950s, 1960s, and 1970s (U.S. Department of Commerce 1952, 1962, 1972, 1982). In the 1980s, the Census Bureau estimates that 100 more people were born than died, but 200 more people moved out of the county than moved into the county (U.S. Department of Commerce 1989a).

Philipsburg, the Granite County seat, had a 1986 population estimated at 1,270 (U.S. Department of Commerce 1989a). The only other incorporated community in the county is Drummond; its 1989 population was estimated to be 420 (U.S. Department of Commerce 1989a). Unincorporated towns in Granite County include Hall, Maxville, and Princeton. A seasonal population also resides in the Georgetown Lake area.

In 1988, Granite County's labor force averaged 1,386 persons; employment averaged 1,272 and unemployment averaged 114 persons. In 1987, the greatest shares of employment in Granite County were in agriculture (18 percent), state and local government (16 percent), manufacturing (15 percent), and retail trade (14 percent) (U.S. Department of Commerce 1989b).

In 1987, persons employed in Granite County earned $15.3 million. Economic sectors with the largest portions of county earnings were: agriculture (19 percent), state and local government (19 percent), manufacturing (16 percent), and mining (13.5 percent)(U.S. Department of Commerce 1989b).

The most important basic industries in Granite County are the agricultural, mining, and forest products industries. Non-local investment income and transfer payments also contribute to operation of the county economy. In 1987, Granite County farm and ranch owners and their employees earned $2.9 million (owners earned $2.0 million and employees $0.9 million) (U.S. Department of Commerce 1989c). Earnings for persons working in agriculture were substantially better in the 1970s than in the 1980s.

Granite County agricultural operations are predominantly cattle ranches. In 1987, there were 140 farms and ranches in Granite County, of which 113 had sales of $10,000 or more. These larger operations accounted for 99 percent of total product sales (U.S. Department of Commerce 1989c). In 1987, agricultural product sales totaled $8.6 million, which was 0.6 percent of statewide agricultural marketing receipts. Cattle sales were $7.9 million, which was 97 percent of total livestock receipts and 92 percent of total agricultural sales for the county (U.S. Department of Commerce 1989c) (see Table 2-2).

Table 2-2. Agricultural Product Sales

| | Sales (in million $) | Percent of Total Sales |
|---|---|---|
| Wheat | 0.038 | 0.4% |
| Hay, Silage, and Field Seed | 0.343 | 4.0% |
| Other Crops | 0.061 | 0.7% |
| Total Crops | 0.442 | 5.1% |
| Cattle and Calves | 7.915 | 92.1% |
| Other Livestock | 0.235 | 2.7% |
| Total Livestock | 8.150 | 94.9% |
| Total Sales | 8.592 | |

Source:
U.S. Department of Commerce 1989c.

The value of Granite County agricultural marketings decreased in the 1980s, primarily as a result of lower cattle prices. Montana cattle prices have fluctuated by more than 100 percent in the last 20 years (Montana Department of Agriculture 1971 through 1989; U.S. Department of Commerce 1989c). When cattle prices have been favorable, Granite County ranches have shown their greatest profits. During years with low prices, ranches have lost money.

Market prices for Montana cattle closely follow national price patterns (Greer 1990). Montana cattle and hay production, instate feedlot and packer situations, and instate consumer demand have only a minor influence on the instate market prices for cattle (Marsh 1990).

Granite County hay production is strongly influenced by precipitation and the availability of water for irrigation. Irrigated and non-irrigated hay production is much greater during moist years. Hay prices are strongly influenced by regional production patterns. The years with the greatest hay production correspond to the years with the lowest hay prices, and low production years bring high prices.

During most years, ranches in Granite County are net purchasers of hay (Dinsmore 1988). The purchase of hay adds to production costs, particularly during dry years when local hay supplies are likely to be low and regional hay prices high. The need to purchase expensive hay may persuade some ranches to sell off cattle, even when cattle prices are unfavorable.

In 1988, the taxable value of land and other property in Granite County was $6.9 million. The taxable value of agricultural land in Granite County was $537,000, which was 7.7 percent of the county's total tax base. Included in this total is irrigated cropland, which accounts for 1.1 percent of Granite County's tax base. Other agricultural property and farm houses were valued at $601,000, which was 8.6 percent of the county tax base (Montana Department of Revenue 1989).

## ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Twenty-five historical and archaeological sites have been recorded (see Table 2-3) in lands within and surrounding the proposed Boulder Creek project. The diversity of site types in the project area is illustrated in Table 2-3, but no comprehensive survey of the affected lands has been conducted. One site--the Princeton Historic Mining District--is listed on the National Register of Historic Places. Based on preliminary investigations, two additional sites have qualities that could make them eligible for listing on the National Register of Historic Places. Sixteen sites would require formal study to assess their potential for contributing important information about the history or prehistory of the area. The project lands are owned by individuals, the Deerlodge National Forest, and the State of Montana. Federal and state antiquities laws would require surveys for historical and archaeological resources prior to

construction across the lands owned by the state and federal government. Similar surveys on private lands would be done at the request of the landowner.

Table 2-3. Recorded Historical and Archaeological Sites in the Boulder Creek Project Area.

| Site Number | Association | Eligibility for listing on National Register of Historic Places |
|---|---|---|
| 24GN0131 | cave | unknown |
| 24GN0132 | homestead | NE |
| 24GN0150 | rock piles | unknown |
| 24GN0189 | historic mining | NE |
| 24GN0190 | historic mining | NE |
| 24GN0191 | historic mining | NE |
| 24GN0207 | historic homestead | PE |
| 24GN0210 | lithic scatter | unknown |
| 24GN0211 | historic homestead | unknown |
| 24GN0212 | historic homestead | unknown |
| 24GN0225 | prehistoric camp | unknown |
| 24GN0279 | historic mining | unknown |
| 24GN0281 | lithic scatter, possible occupation | unknown |
| 24GN0282 | lithic scatter | unknown |
| 24GN0283 | lithic scatter | unknown |
| 24GN0284 | lithic scatter | unknown |
| 24GN0285 | lithic scatter | unknown |
| 24GN0286 | lithic scatter | unknown |
| 24GN0287 | prehistoric camp | unknown |
| 24GN0291 | lithic scatter | unknown |
| 24GN0292 | historic homestead | unknown |
| 24GN0420 | historic mine equipment | E |
| 24GN0421 | historic mining district | E listed |
| 24GN0445 | lithic scatter, historic timber harvest | unknown |
| 24GN0446 | historic bridge | NE |

E = Eligible
NE = Not Eligible
PE = Potentially Eligible

Source: Schwab 1988

# CHAPTER THREE
# IMPACTS OF THE PROPOSED RESERVATION AND ALTERNATIVES

This chapter describes the environmental impacts of granting GCD's water reservation and constructing the proposed Boulder Creek dam and irrigation project. As discussed in Chapter One, the analysis is based on preliminary information. Additional information would need to be collected before the project is constructed. At the time of construction, a second, more detailed EIS may be required.

The impact analysis also includes a discussion of the combined effects of granting GCD water reservations on both Boulder Creek and the North Fork of Lower Willow Creek. The impacts of granting GCD a water reservation on just the North Fork of Lower Willow Creek are more thoroughly discussed in the draft EIS (DNRC 1988).

Because of uncertainties concerning the availability of water for the proposed project, two possible scenarios are addressed this chapter. In the first case, existing downstream water rights would constrain development, effectively limiting the amount of water available for new consumptive uses. Changes of existing water uses would still be possible where these changes did not adversely affect other uses in the basin. In the second case, existing water rights would not limit additional consumptive use. Water would be available in spite of existing water rights, and new development could occur. Each of these cases produces different results and impacts, and the reader should bear in mind which case is being presumed for any particular analysis.

The final section of this chapter describes the alternatives to the Boulder Creek reservoir that DNRC investigated. DNRC analyzed five alternatives to GCD's proposed development. DNRC did not address the environmental impacts of developing these alternatives, because none of the alternatives were economically feasible.

## CASE 1. EXISTING WATER RIGHTS CONSTRAIN DEVELOPMENT

If the Board grants GCD's Boulder Creek reservation request, and existing water rights do, in fact, constrain water use either before or after construction of the proposed reservoir, then GCD could not use its reservation. In terms of water use, there would be no impacts. Objections to the pending water reservation applications may be filed by anyone whose property, water rights, or interests may be adversely affected by the proposed reservation. In particular, holders of existing irrigation claims and permits in the Boulder Creek and Flint Creek drainages might object to GCD's requested reservation. GCD is also concerned that "large hydropower water rights...could limit water storage for the project" (GCD 1987). To date, WWP and MPC have not objected to the issuance of any new water-use permits and have not curtailed water use by junior appropriators. A contested case hearing will be held to resolve

any objections.

GCD has described four approaches that might be applied to overcome constraints that could be posed by hydropower water rights in particular. These approaches are discussed below. If any of these approaches were successful, and GCD did develop the proposed project, then the impacts described under Case 2 would occur.

1. "Federalize the proposed Boulder Creek project and in doing so subordinate downstream hydropower rights. The federal licenses for these downstream hydroelectric projects already contain certain conditions which allow for their subordination to future upstream federal development, albeit at a cost." (GCD 1987)

The federal licenses for all the hydropower projects on the Clark Fork stipulate that the use of water for hydropower production is subordinate to the use of water in federal water projects. In other words, if developers such as GCD can obtain federal sponsorship, the holders of hydropower rights could not object to the project, even though hydropower generation might be adversely affected. Only Congress can authorize a federal water project. In GCD's application, the steps required for federal authorization are outlined in some detail. Essentially, GCD would seek congressional authorization and funding through the Small Reclamation Project program (Public Law 85-984). This process requires a feasibility study including an environmental impact statement, approval from the Bureau of Reclamation, and Congressional action appropriating funds for the project.

While economic feasibility is not a strict requirement of the Small Project Loan program, the ability to repay the loan is. Based on DNRC's analysis, as discussed in Chapter Four, the proposed project will not pay for itself. However, if the irrigators are willing to assume the financial risk of investing in the project or if state funding could be acquired to help pay for project development, there is some chance that the project could qualify for the federal program and be authorized.

2. "Negotiate an exchange of water rights between WWPC, MPC, and Hungry Horse Reservoir. Hungry Horse is a Bureau of Reclamation project that was established for multiple purposes which include irrigation." (GCD 1987)

Water released from Hungry Horse Reservoir might be exchanged for water depleted by additional irrigation in the upper Clark Fork basin. This exchange water would make up for reduced flows at the Thompson Falls and Noxon Rapids power plants, but would not mitigate the depletions above Milltown Dam. Hungry Horse Reservoir is located on the South Fork of the Flathead River and is situated upstream from Kerr Dam. MPC's Thompson Falls Dam and WWP's Noxon Rapids Dam are not far from the Montana-Idaho border.

The Bureau of Reclamation (USDI 1988a) studied the effect of an additional 120,000 acres of irrigation development in the

entire Clark Fork basin and 30,000 acres in the upper Clark Fork basin. The Bureau concluded that although power generation losses at Thompson Falls and Kerr Dam could be mitigated and generation even enhanced by water releases from Hungry Horse Reservoir, generation losses at Noxon Rapids Dam could not. Even though Hungry Horse reservoir is authorized for irrigation uses, the Bureau was concerned that the existing allocation of Hungry Horse's storage for power generation and instream flows may be adversely affected by such an exchange. In addition, the Bureau noted that exchanges of water would cause increased reservoir fluctuations at Hungry Horse. At 4,093 acres, GCD's proposed project would be substantially smaller than the amount of development examined in the Bureau's study.

3. "Attempt to subordinate the WWPC and MPC projects to upstream developments by inclusion of such terms in the relicensing of these projects. Currently some of these projects are up for relicensing." (GCD 1987)

Attempts to subordinate hydropower water rights to other upstream uses have not been successful. In past instances, DNRC has intervened in the FERC relicensing of hydropower facilities, requesting that FERC subordinate hydropower water use to all upstream consumptive uses. To date, FERC has not accepted DNRC's requests. However, FERC has the authority to make subordination a condition of federal hydropower licenses if it is deemed to be in the public interest. The purpose of past DNRC interventions was to ensure representation of state interests in specific FERC relicensing hearings. The state may or may not support such subordination requests in the future.

4. "Subordinate hydropower uses to upstream developments via state legislation. This would require a prior amendment to the Federal Power Act." (GCD 1987)

No such changes are pending in the U.S. Congress, and none have passed the state legislature. However, western states are currently working to amend the Federal Power Act to give states a greater voice in FERC's decisions. Specific wording that would subordinate hydropower generation is not, however, contained in any draft legislation currently being evaluated by the western states. The outcome and possible policy changes associated with this effort are unknown at this time.

## CASE 2. EXISTING WATER RIGHTS DO NOT CONSTRAIN FUTURE WATER USE

### WATER QUANTITY

To assess the impacts of granting GCD's requests on Boulder Creek and the North Fork of Lower Willow Creek, DNRC hydrologists developed three computer simulation models. The first model simulates flows in Boulder Creek and Flint Creek and was used to analyze the impacts of the proposed Boulder Creek project. The second model simulates flows in the North Fork of Lower Willow Creek and was used to analyze the combined impacts of granting GCD's requests on both Boulder Creek and the North Fork of Lower Willow

Creek. The final model simulates flows on the main stem of the Clark Fork from its headwaters to Noxon dam.

All three models employ mass balance computations to simulate streamflows, reservoir operations, diversions, and return flows at various nodes (locations) within the Clark Fork basin. The models operate on a monthly time step over the base period 1951-1986. Data input to the models includes gauged and estimated streamflows, crop irrigation requirements, irrigation efficiencies, irrigated acreage, reservoir capacities, and evaporation rates. Streamflow data were obtained from the USGS gauging records or estimated using techniques described in DFWP's application (DFWP 1986). Estimates of crop irrigation requirements were obtained from the Soil Conservation Service (USDA 1967). Estimates of irrigation efficiencies were based on information gathered by Elliot (1986), GCD (1987), and USDA (1978b).

Return flows were estimated by subtracting crop consumptive use and an estimate of non-beneficial consumptive use from the irrigation diversion. Non-beneficial consumptive use (water which is lost to evaporation, phreatophyte use, or deep percolation to non-contributing groundwater sources) was assumed to be 15 percent of the water diverted in excess of the crop consumptive use. The remaining 85 percent of water diverted in excess of crop consumptive use is assumed to be returned to the streams. Return flows re-enter streams over a period of several months (Glover 1978, Brustkern 1986), with most of the return reaching the stream within the first two to three months after irrigation. DNRC analyses assumed that approximately 50 percent of the excess diverted water returns to the stream in the month it is diverted for irrigation, and 25 percent returns in the month following irrigation. Return flows in each subsequent month are assumed to be one-half as much as the previous month until returns are effectively zero.

The accuracy of the Boulder Creek and Lower Willow Creek models was checked by comparing modeled flows for existing conditions to limited historical flow data collected near the mouth of Flint Creek. Comparisons generally indicated a good agreement between the two sets of data. A summary of modeling results is presented in Appendix A. Table 3-1 shows the difference in average flows and the percentage change for these four locations along the Clark Fork main stem. Figures 3-1 through 3-4 show the difference between average annual flows with and without the proposed Boulder Creek project at two locations in Boulder Creek, at Flint Creek near Drummond, and on the Clark Fork main stem below Flint Creek. Figure 3-5 shows Boulder Creek reservoir volume.

Table 3-1. **Changes in Average Flows -- Proposed Boulder Creek Project**[a]

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boulder Creek below Proposed Reservoir** | | | | | | | | | | | | | |
| Average Change | -14[b] | -14 | -11 | -9 | -8 | -7 | -8 | -32 | -48 | -48 | -15 | -16 | -13,928 |
| Percent Change | -67% | -67% | -58% | -53% | -47% | -44% | -33% | -31% | -29% | -84% | -79% | -94% | -46% |
| **Boulder Creek at Maxville** | | | | | | | | | | | | | |
| Average Change | -13 | -14 | -11 | -9 | -8 | -7 | -8 | -32 | -47 | -45 | -12 | -14 | -13,319 |
| Percent Change | -50% | -54% | -48% | -45% | -40% | -37% | -28% | -27% | -25% | -71% | -60% | -70% | -38% |
| **Flint Creek near Mouth** | | | | | | | | | | | | | |
| Average Change | 1 | -7 | -8 | -8 | -8 | -7 | -8 | -28 | -30 | -14 | 12 | 17 | -5,309[c] |
| Percent Change | <1% | -5% | -7% | -9% | -8% | -6% | -5% | -7% | -7% | -16% | 22% | 10% | -4% |
| **Clark Fork below Confluence with Flint Creek** | | | | | | | | | | | | | |
| Average Change | 1 | -7 | -8 | -8 | -8 | -7 | -8 | -28 | -30 | -14 | 12 | 17 | 5,309[c] |
| Percent Change | <1% | -1% | -1% | -1% | -1% | <-1% | <-1% | -2% | -2% | -2% | 3% | 3% | <-1% |

a Period of record: 1951 through 1986.
b Negative values indicate a reduction in stream flow.
c The annual depletion at the mouth of Flint Creek and below are smaller than those near Maxville due to irrigation return flows.

Figure 3-1

Boulder Creek below Proposed Reservoir
With and Without Proposed Boulder Creek Project

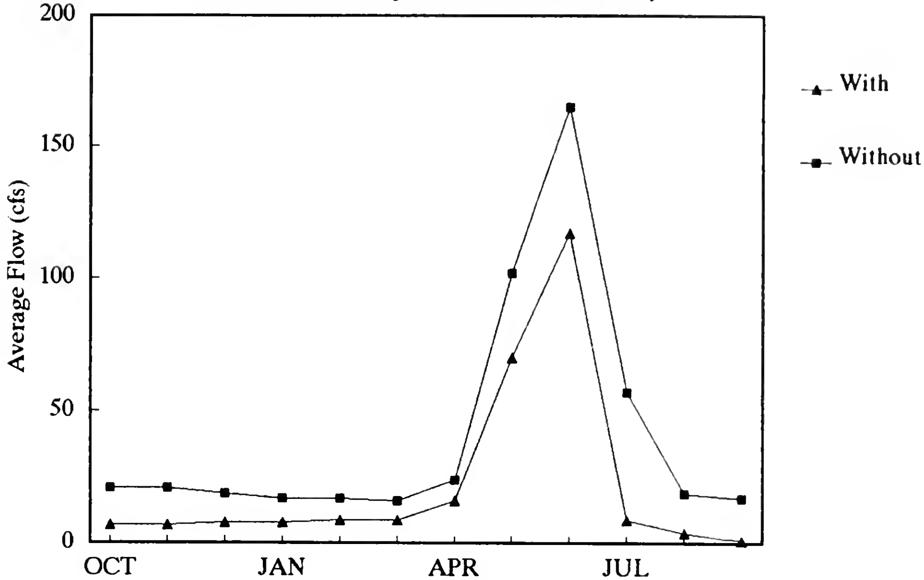



Figure 3-2

Boulder Creek at Maxville
With and Without Proposed Boulder Creek Project

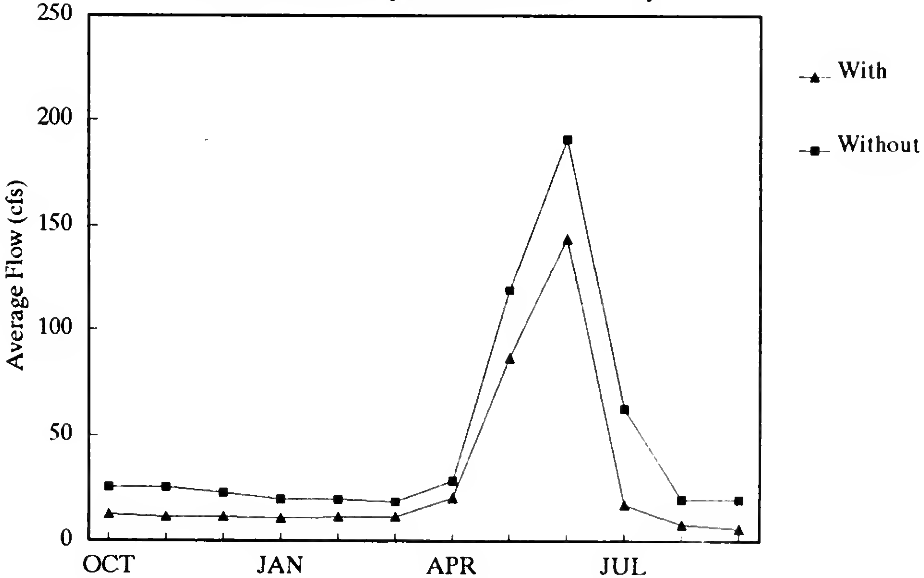


Figure 3-3

Flint Creek near Mouth
With and Without Proposed Boulder Creek Project

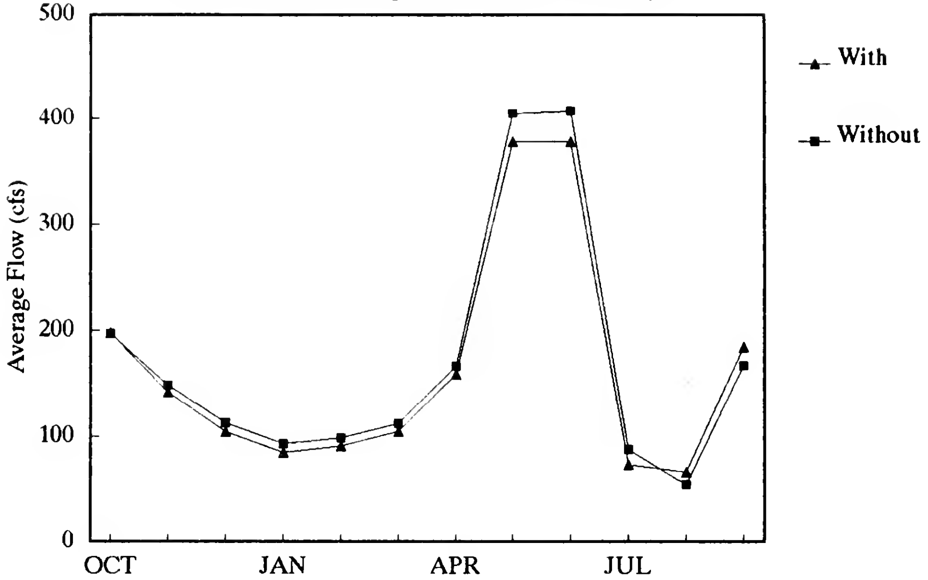



Figure 3-4

Clark Fork below Confluence with Flint Creek
With and Without Proposed Boulder Creek Project

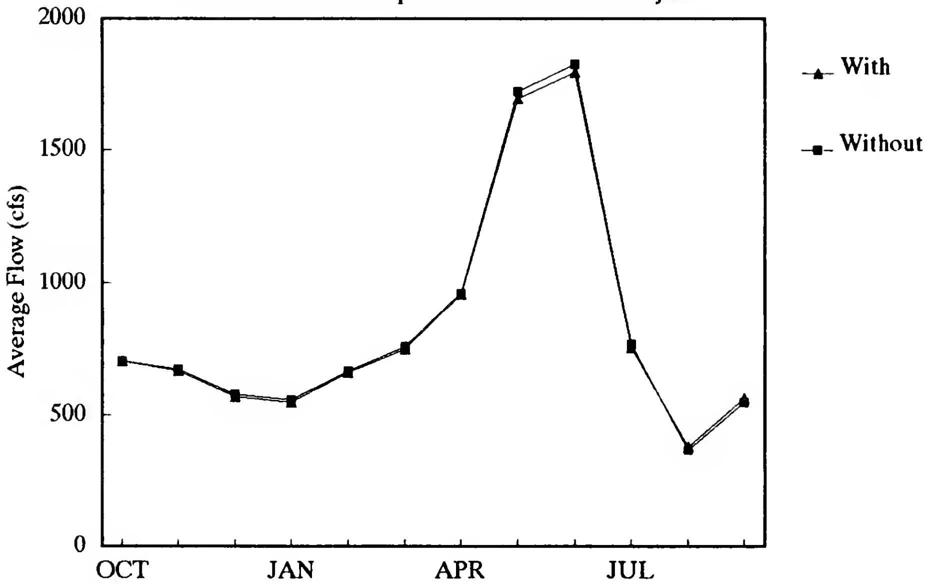
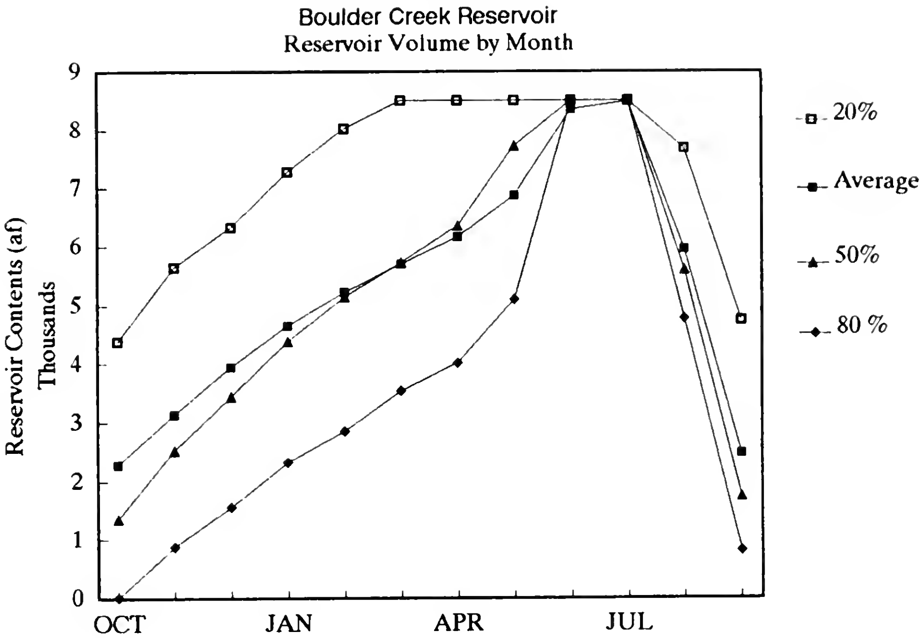


Figure 3-5


Boulder Creek Reservoir
Reservoir Volume by Month
Reservoir Contents (af)
Thousands
9
8
7
6
5
4
3
2
1
0
OCT
JAN
APR
JUL
20%
Average
50%
80 %

The most dramatic changes in stream flows would occur in Boulder Creek. The average annual discharge cf Boulder Creek would be reduced by 13,928 af (47 percent) just below the proposed reservoir and by 13,319 (38 percent) near Maxville. The reduction would be slightly less near Maxville due to canal seepage returning to Boulder Creek between the proposed reservoir and Flint Creek. In September, Boulder Creek flows just below the proposed reservoir would be reduced to 1 cfs, an average reduction of 16 cfs.

Flint Creek flows near Drummond would be reduced by 5,309 af (4.28 percent) on average. As shown in Figure 3-3, flows would be depleted from November through July, on average. However, because of irrigation return flows, stream flows during August, September, and October would increase on average. In low flow years, Flint Creek near Drummond and the Clark Fork main stem would benefit from return flows in July, August, September, and October.

DNRC analyzed flow reductions at the Allendale Canal diversion and found that there was sufficient water to meet the state water right. However, DNRC was not able to determine whether there would be sufficient water to meet existing demands between the Allendale diversion and where the return flows begin to enter Flint Creek. Specifically, diversions from Flint Creek between Boulder Creek and Douglas Creek could be adversely affected by reduced flows. However, senior water right holders would have the legal right to use this water. To satisfy these existing rights, GCD might have to make releases equal to reservoir inflow.

GCD's hydrologic analysis accounted for 238 acres of existing irrigation diverting directly from Boulder Creek. However, DNRC's investigation of water right records found a total of 710 irrigated acres with Boulder Creek water right claims. The impact of passing flows to these additional 472 acres would be to reduce project reliability from 95 percent to 80 percent. (Reliability is based on the number of years that the project receives a full water supply divided by the period of record.) If downstream claims on Flint Creek require summertime releases from the proposed Boulder Creek reservoir, a similar reduction in project reliability would occur.

DNRC also evaluated the combined impact of granting GCD's requests on both Boulder Creek and the North Fork of Lower Willow Creek. Table 3-2 and Figures 3-6 and 3-7 summarize information concerning the combined impacts. Appendix A includes the complete output of the hydrologic model. If both projects were built, annual depletions would total 6,839 af at the mouth of Flint Creek.

**Table 3-2. Changes in Average Flows -- Proposed Boulder Creek and[a] North Fork of Lower Willow Creek Projects**

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Flint Creek near Mouth** | | | | | | | | | | | | | |
| Average Change | 6 | -4[b] | -7 | -8 | -7 | -8 | -15 | -58 | -40 | -14 | 18 | 24 | -6,839 |
| Percent Change | 3% | -3% | -6% | -9% | -7% | -7% | -9% | -14% | -10% | -16% | 32% | 14% | -6% |
| **Clark Fork below Confluence with Flint Creek** | | | | | | | | | | | | | |
| Average Change | 6 | -4 | -7 | -8 | -7 | -8 | -15 | -58 | -40 | -14 | 18 | 24 | -6,839 |
| Percent Change | <1% | <-1% | -1% | -1% | -1% | -1% | -2% | -3% | -2% | -2% | 5% | 4% | -1% |

[a]Period of record: 1951 through 1986.
[b]Negative values indicate a reduction in stream flow.

Figure 3-6

Flint Creek near Mouth
With and Without Proposed Boulder Creek and N.F. Lower Willow Creek

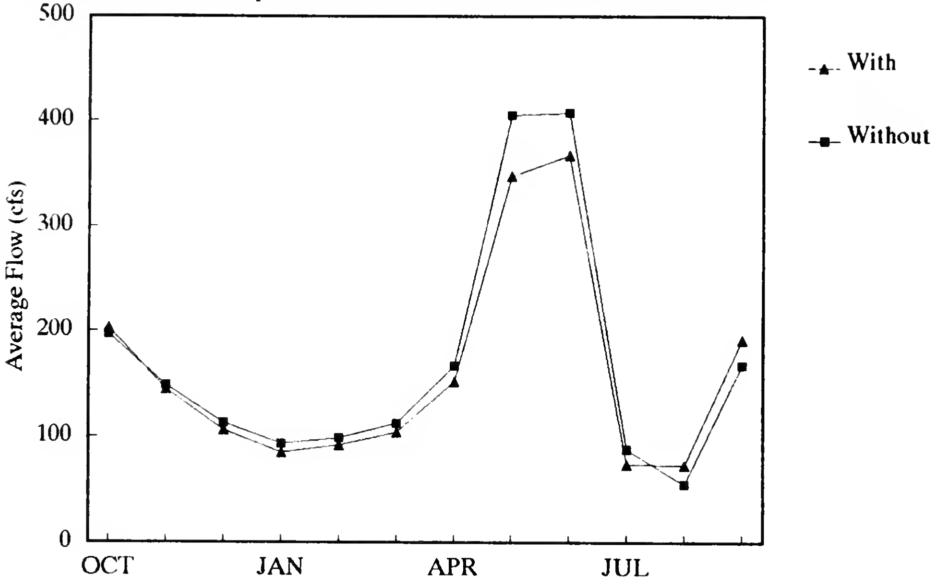
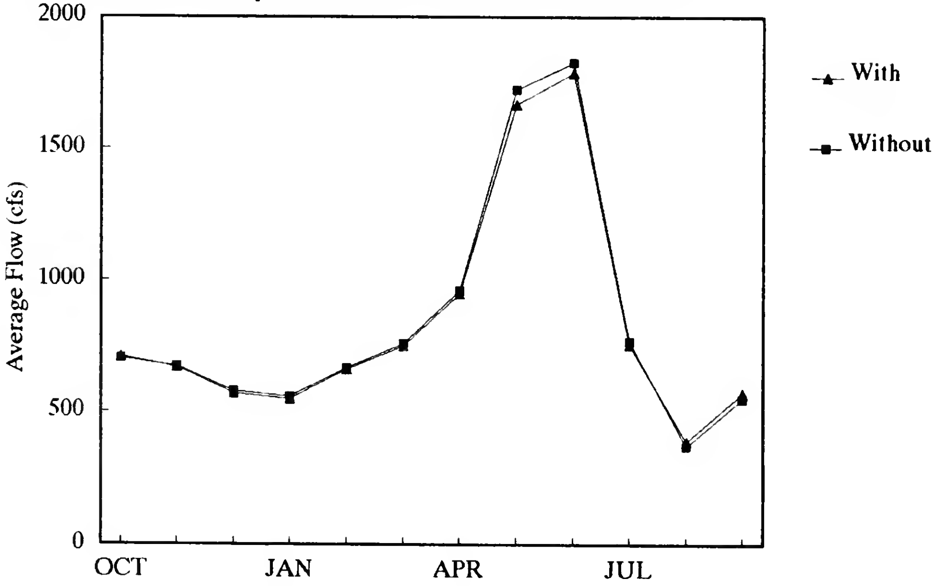



Figure 3-7

Clark Fork below Confluence with Flint Creek
With and Without Proposed Boulder Creek and N.F. Lower Willow Creek



**WATER QUALITY**

Increases in sediment in Boulder Creek are expected as a result of project construction. No sediment control measures during construction have been proposed by GCD at this time. If the reservation is granted, the Board may require GCD to develop and implement a sediment control and monitoring plan.

Water temperatures in Boulder Creek would change below the proposed reservoir. The magnitude of these changes will depend on the final project design and operating plan. In general, releases from a reservoir of this type will tend to remain cooler than present during the early summer.

Sediment levels in Douglas Creek would increase due to the use of the stream channel to convey project water until the channel has adjusted. As explained in Chapter One, the main canal would empty into Douglas Creek. The water would flow down Douglas Creek for approximately one mile and would then be diverted back into a canal.

The Boulder Creek project would reduce flows available to dilute arsenic in Flint Creek below Maxville and downstream in the Clark Fork main stem. But if Boulder Creek above the proposed reservoir site happens to be the major source of arsenic in the Flint Creek drainage, then the project would reduce arsenic concentrations in Flint Creek and in the Clark Fork. Additional water quality sampling would be necessary to determine whether Boulder Creek is such a source and if project depletions would violate state water quality standards. DNRC plans to collect water quality samplings in the drainage before the contested case hearing is held.

On the Clark Fork main stem, flows would be reduced slightly while the project is storing water and during the early irrigation season. Slight increases in flows would result from irrigation return flows in the late summer and early fall. Downstream, as other tributaries enter the Clark Fork main stem, these changes become less significant. These changes in flow would not appreciably affect metals dilution or dissolved oxygen levels.

**FISHERIES**

Approximately 1.3 miles of stream, including a meadow/marsh area created by numerous beaver ponds, would be inundated by the proposed Boulder Creek reservoir. The pools behind the beaver dams now support a resident trout population. Above the reservoir site, cutthroat and bull trout have been found, while below the proposed dam site brown, bull, and cutthroat trout have been found. The total surface area of the project impoundment would fluctuate between less than 10 and 145 acres. In GCD's application, approximately 170 af of storage in the reservoir has been allocated for sediment accumulation and a conservation pool. The conservation pool would have a surface area of approximately 15 acres and an average depth of 11.3 feet. The pool may be larger and deeper if the soil upstream of the proposed dam site is excavated and used in the dam construction. Sediment will eventually fill the

conservation pool, although how long this accumulation will take is not known. A population of cutthroat trout might be supported in the reservoir until the conservation pool is filled with sediment. After the pool fills with sediment, the reservoir is expected to be drained to 10 to 20 feet deep in roughly 2 years out of 10 in October, and occasionally will be completely drained in October. Any fishery in the reservoir would be destroyed by these complete drawdowns. Unless fish are planted in the reservoir, fish in the upper drainage will be slowly recruited until the reservoir is repopulated, or until another complete drawdown.

Flows in Boulder Creek below the proposed dam would be drastically reduced as shown in Figure 3-1. In the summer and fall, average flows below the proposed reservoir would be reduced by 29 to 94 percent (see Table 3-1). This is expected to have a substantial detrimental effect on the aquatic habitat in Boulder Creek between the dam and the South Fork of Boulder Creek.

Flows from Wyman Creek and the South Fork of Boulder Creek would continue to contribute to flows between the dam site and Boulder Creek's confluence with Flint Creek. However, average monthly flows in Boulder Creek would still be reduced from aproximately 25 to 71 percent near Maxville. The project would reduce average flows below 10 cfs in all but 3 months during low flow years. In average or better flow years, flows would fall below 10 cfs in August and September. Ten cfs represents a minimum flow level for maintaining aquatic habitat, as defined by DFWP's wetted perimeter methodology (DFWP 1986). Reducing the flow below 10 cfs results in a rapid reduction of aquatic habitat which, in turn, would dramatically reduce food production. This reduction in habitat and food production would likely reduce fish populations below the dam. Sufficient data on fish populations are not available to develop a quantitative relationship between stream flow and fish population.

Bull trout have been reported to migrate up Boulder Creek in the fall to spawn (DFWP 1986), but this has not been confirmed. The proposed dam would block any migration that may be occurring in the upstream reach. Depletions below the dam would reduce aquatic habitat and may also impede spawning. These changes could decrease Bull trout populations, a species of special concern. These impacts could be mitigated by releasing additional water from the reservoir to maintain downstream flow.

Flint Creek flows would decrease below its confluence with Boulder Creek. Return flows from irrigated lands and ditch seepage would return to Flint Creek before its confluence with the Clark Fork. As a result, near the mouth of Flint Creek, flows would generally decrease in the winter and spring and increase in the late summer and fall. There would be corresponding changes in aquatic habitat. Similar flow regimes and corresponding changes in aquatic habitat in Flint Creek would occur if both the Boulder Creek and North Fork of Lower Willow Creek projects operated at the same time (see Appendix A). In the Clark Fork main stem, changes in flow would be too small

to significantly affect aquatic habitat.

**RECREATION**

Granting the requested Boulder Creek reservation would create a reservoir approximately 1.3 miles long and 0.3 miles wide. Assuming that GCD would allow public access, the reservoir would provide some limited fishing and boating opportunities in most years. In average flow years, reservoir depths would range from 127 to 75 feet near the dam, with reservoir surface area varying from 15 to 145 acres. Shallowest depths would occur in the fall, ranging from 75 to 84 feet near the dam. In low flow years (2 years out of 10) reservoir volume would vary from 8,500 to 15 af, with reservoir surface area varying from less than 10 acres to 145 acres. Yearly drawdowns of the reservoir would expose bare benches in the upper end of the reservoir and could degrade recreational experiences and make access more difficult. Destruction of the reservoir fishery by complete drawdowns in low flow years would severely limit fishing opportunities until the reservoir is repopulated. Reservoir depth would decrease as sediment slowly fills the reservoir.

Existing recreation on private lands within the valley bottom would be displaced, and a section of existing county road which provides access to the upper Boulder Creek drainage would be inundated. Access to the upper drainage would have to be maintained if existing recreation uses on U.S. Forest Service land would continue. Recreationists might experience temporary inconvenience during the construction period for the new road. Further, the new access road will likely be longer and travel time would increase.

Median instream flows in Boulder Creek below the proposed dam would decrease an average of 67 percent, with largest decreases occurring in July, August, and September at 89, 76, and 93 percent respectively (see Appendix A). Because streamflow is typically only one of several physical and biological variables that can affect fish abundance, potential for adverse effects on recreational fishing from changes in streamflows, aquatic habitat, and game fish populations can be generally identified but not specifically described or quantified. Potential adverse effects on recreational fishing in Boulder Creek are possible due to likely reductions in fish populations below the dam. If both the Boulder Creek and North Fork of Lower Willow Creek projects operate at the same time, instream flows in the Clark Fork below Flint Creek would show average yearly decreases of 1 percent or less. Average flows would vary from 3.3 percent decreases in May to 4.8 percent increases in August. These flow variations would not noticeably affect recreation on the Clark Fork main stem.

Average instream flows n the Clark Fork at Missoula would vary 1 percent or less from month to month with the simultaneous operation of the Boulder Creek and North Fork of Lower Willow Creek projects. These flow variations would not be discernible.

## VEGETATION AND WILDLIFE

GCD's planned reservoir would inundate about 145 acres of habitat used by mule deer, moose, mountain grouse, beaver, and songbirds. Roughly 1.3 miles of possible habitat for tailed frogs would be destroyed. Movements of deer and beaver up and down Boulder Creek would be impeded (Murphy 1987). Impacts to deer would be reduced by their ability to establish new travel routes. While the dam and associated facilities are being constructed, wildlife would be displaced from the construction area. Because the affected habitats are not considered critical, impacts to overall populations of the above-mentioned species would not be significant.

Once completed, the reservoir could serve as habitat for waterfowl and muskrats. The amount of the habitat would vary with water levels. Big game could eventually use shoreline areas.

The proposed canal would remove about 206 acres of vegetation and wildlife habitat. Access roads and trails would remove additional acreage. Losing this relatively small amount of habitat would probably not significantly affect wildlife; however, the canal route could contain unique or valuable resources and should be surveyed before construction begins. Animals would use canal-side vegetation and water in the completed canal.

Converting 4,093 acres of dry rangeland to irrigated cropland would increase forage for deer. In years when grain crops are grown, migrating waterfowl would find additional feeding areas. This wildlife benefit can also be seen as a cost to project irrigators.

The reservoir would substantially reduce flows in the lower reach of Boulder Creek (see Table 3-1), eventually reducing the vigor of riparian vegetation. As the vegetation deteriorates, moose, deer, elk, and mountain grouse habitat would be lost. Aquatic habitat used by mink and beaver would significantly decline. Low flow during winter would result in the exposure and possible freezing of beaver food caches, lodges, or bank dens.

## LAND USE

The proposed Boulder Creek project would inundate approximately 145 acres of marginal grassland and forest and preclude the incidental grazing that occurs there. One house, located about 1/4 mile above the proposed dam, would be inundated. The reservoir would also inundate a section of the county road extending from Highway 1. This road is the main access to the townsite of Princeton, the national forest lands, and BPA road networks (GCD 1987), so an alternative access would need to be developed. GCD's application does not identify the inundation of the road as an impact or identify any alternative access route. Project construction could also inconvenience Granite County travelers if construction activities temporarily slow movement of vehicles on Highway 1 and local roads.

A 1.3 mile section of road to Princeton could be relocated east

of its present alignment, although this would require construction on steep side hills. Based on U.S. Forest Service road construction costs (Cain 1990), a new road would cost more than $50,000 a mile to construct. Another alternative would be to improve and use the national forest and BPA road network east of the Boulder Creek valley. These routes are precipitous and windy in spots, would dramatically increase travel time and distance, and would be less safe than the route closer to the valley floor.

Because the proposed reservoir would be upstream of several permanent homes, the dam would likely be classified as high hazard. GCD did take this into account and proposed building an emergency spillway of adequate size to pass 21,800 cfs, the probable maximum flood (GCD 1987). However, if the dam did fail, there would be little or no time to evacuate people living below the dam and residents of Maxville. Prior to construction, a qualified engineer would have to reevaluate the safety of the proposed dam design. The dam would then have to be classified and receive a construction permit from DNRC's Dam Safety program (36.14.305-312 MCA). If the dam is classified as a high-hazard dam, an operation permit is also required (36.14.401-407 MCA). The operations plan consists of the reservoir operation, a maintenance procedure for the dam and appurtenant works, and emergency procedures and warning plans.

The main canal that would deliver reservoir water to project lands would occupy approximately 206 acres within a 50-foot strip and would remove this land from other uses. More land would be removed where cuts and fills would be required for construction access to steep hillsides, but land use on these steep hillsides is limited. Access from Highway 1 to the benchlands and hillsides east of the canal would be more difficult and expensive because bridges would be required to cross the canal. The probable route of the main canal is close to flood-irrigated acreage in the Southeast Quarter, Section 36, Township 9 North, Range 13 West. Location of the canal on irrigated ground would disrupt the existing ditch network and might isolate productive parcels of land.

Boulder Creek project water would be used to irrigate 4,093 acres of rangeland north of Maxville (see Figure 1-1). The project could dramatically increase the productivity of this land. DNRC estimates that yields would increase from the existing maximum of 0.25 animal unit months (AUMs) per acre to an average alfalfa yield of approximately three tons per acre and one AUM per acre.

## EARTH RESOURCES

The earth resources impacts of the proposed action would result from construction of an earthen dam across Boulder Creek and construction of main and lateral water delivery canals. The dam would be approximately 1,150 feet long, 145 feet high, and would contain 1,286,000 cubic yards of earth fill material. A limited substrate drilling program conducted by the Soil Conservation Service (USDA 1978a) at the dam site indicates that sufficient valley fill for dam construction

may be available upstream of the impoundment site. Should this be the case, downstream impacts of dam construction would be limited to shallow surface disturbances and compaction caused by vehicle traffic, equipment and fuel storage, and placement of maintenance shops and construction offices. If upstream fill material is insufficient, downstream areas within the Boulder Creek alluvium would be quarried for impoundment fill. This disturbance cannot be quantified without a more thorough survey.

Approximately 145 acres of Boulder Creek bottom land would be inundated by the reservoir. Most of this area consists of alluvial soils supporting riparian vegetation. Smaller areas along the margins of the drainage bottom with colluvial soils supporting timber would also be flooded. Soil productivity within the inundated area would be permanently lost.

The proposed action includes the construction of approximately 34 miles of earthen canal. The proposed canal route traverses a wide range of slope gradients dictating the width of the construction disturbance. Assuming a 50-foot construction corridor along the entire main canal, approximately 206 acres would be disturbed. Canal construction on steep slopes would increase the disturbed area because of earthwork required to reduce slopes above the canal and down-slope deposition of excavated material.

Accelerated soil erosion, decreased production of desirable forage species, and increased annual weed infestation would occur along the construction corridor until it is stabilized by perennial vegetation. Increases in surface water turbidity are likely where streams intersect construction areas. The channel of Douglas Creek in Sections 24 and 25, Township 9 North, Range 13 West, would convey water between two separate segments of the main canal. Channel scouring with resultant streambank erosion and downstream sedimentation are would occur until the channel has adjusted to increased flows during the irrigation season.

The first four miles of the proposed canal traverse talus slopes and bedrock outcrops along the flank of the Boulder Creek drainage. An unlined canal through talus and blasted bedrock is likely to experience excessive seepage and possible destabilization of the slope. The proposed canal crosses the surface of old landslides in Section 3, Township 8 North, Range 13 West, and Section 35, Township 9 North, Range 13 West. Canal seepage into these landslides would increase the probability of future slope failure. Failure would potentially damage the Gird Creek roadway, may endanger grazing livestock, and would elevate turbidity and sedimentation of downslope surface waters. Canal failure would also be very costly to project irrigators.

Current land uses on the proposed 4,093 acres of irrigated area are livestock grazing and dryland cropping. Any new adverse impacts to the project area lands as a result of irrigation would depend in part upon the present condition of the rangeland. Ungrazed or well-managed rangeland

in good or excellent condition is likely to experience an increased rate of erosion from a typical 8-year rotation of irrigated small grains and alfalfa production. Overgrazed rangeland in fair or poor condition may experience less soil erosion once converted to irrigated crop production.

Several impacts to the soils are likely after the conversion of rangeland to cropland. Organic carbon decreases of 25 to 60 percent and total nitrogen decreases of 24 to 50 percent have been measured by several researchers (Blank and Fosberg 1989, Baur and Black 1981, Campbell and Souster 1982, Dormaar 1979). These changes are likely to result in decreased water holding capacity, increased susceptibility to erosion, and an increased need for chemical fertilizers (Blank and Fosberg 1989, Campbell and Souster 1982). These impacts may be offset somewhat if alfalfa is the assumed crop. The addition of alfalfa residues and residues left by crops benefiting from alfalfa-fixed nitrogen may lessen the loss of organic carbon. An alfalfa crop would provide more protection from soil erosion than a more intensive cropping system. The conversion of grain crops to alfalfa would contribute plant-available nitrogen, reduce erosion, and add crop residues.

Impacts to the soil will result from the change from dryland to irrigated agriculture. Irrigation leads to the accumulation of soil salts. Under proper irrigation management, salts will be leached below the root zone. Marine shale exists at the surface and beneath a veneer of sediments within the proposed irrigated area. Although no salinity problems have been recorded in the area, saline seep development on marine shales elsewhere in Montana should alert projects developers to potential problems.

## SOCIOECONOMIC IMPACTS

### Population Impacts

During construction, GCD's proposed project on Boulder Creek would employ about 125 workers over a two-year period (Walker 1988). Although some workers might choose to commute from their homes in nearby counties, the influx could cause a small, temporary increase in county population. The county is likely to continue to lose population, however, and the Boulder Creek project would have only a slight impact on the long-term population trends of the county.

The Boulder Creek project is economically infeasible (see Chapter Four, Public Interest). However, if the project receives large state and federal subsidies, the project may be financially feasible from the local perspective. If subsidies are received, the Boulder Creek project could improve the economic viability of participating ranches and help sustain the area's agricultural population. Approximately 10 family-owned ranches would use water supplied by the project (Dinsmore 1988). Increased profits for local ranches could boost expenditures at businesses in Philipsburg and Drummond and improve the ability of these communities to maintain their populations.

If the irrigation project was financially unsuccessful for participating ranches, it could hasten the reduction in the number of family operations in the county. An unsuccessful project could also contribute to reduced expenditures at local businesses, thus diminishing the abilities of local towns to sustain their populations.

## Economy

### Short-Term Economic Effects

Building the dam, reservoir, and water delivery system could provide a short-term boost to the local economy. Granite County residents employed in construction of the project would benefit personally from the jobs and income created by construction activities. Local businesses would temporarily benefit from increases in local purchases resulting from income growth for local residents and expenditures by non-local construction workers. Local ranchers might benefit from the sale of materials such as sand, gravel, and fill used in project construction.

Some businesses and individuals would also benefit from the sale and installation of irrigation and other farm equipment needed to deliver water to the new irrigated land. Equipment purchases would not necessarily be made from Granite County businesses.

### Long-Term Economic Effects

The proposed irrigation project would not have major effects on the overall economy of Granite County, but could significantly affect the economic well-being of participating ranching families and have slight effects on personal earnings in some county businesses.

In years when water is fully available, DNRC estimates that the Boulder Creek project is capable of producing about 10,000 tons of hay. The increase in local hay production could allow the 10 participating ranches to expand cattle production by an estimated 5,300 head. The project could increase the county's average annual hay production and cattle production by about 16 percent, resulting in a substantial increase in agricultural output.

The effect of the project on the economic viability of the ranches would generally depend on whether the marketing revenues from greater hay and cattle production would exceed additional operating costs.

If the project receives large federal or state subsidies, project irrigators could break even and possibly make a profit. However, even with these subsidies ranchers participating in the Boulder Creek project would be accepting substantial financial risk (see Chapter Four, Public Interest). The greatest benefit of the Boulder Creek project to these irrigators would result if hay production is significantly increased during low water years. Additional hay production would improve the ability of local ranchers to hold on to cattle when

prices are unfavorable, and then sell cattle when prices are higher and opportunities for profit are the greatest.

If the project receives federal or state subsidies and is constructed, the participating ranchers may not improve their situation if they do not receive water during low flow years. Because GCD did not account for existing uses of Boulder Creek and Flint Creek water, water might not be available to the project in low flow years. In these years, ranchers would have to purchase relatively expensive hay and still be obligated to pay for the project.

The other marketing option for participating ranches would be to sell hay to other ranchers. During most years, Granite County ranches are net-importers of hay (Dinsmore 1988). Use of more locally produced hay would reduce the loss of local money to outside economies and reduce transportation costs, while increasing the local value added for in-county cattle production. If the hay were sold to out-of-county users, the project would benefit Granite County by bringing outside money into the local economy. On the other hand, project development also means additional debt for participating ranchers, making it harder to stay in business during bad years.

Even if the irrigation project did increase the profitability of local ranches, it would not increase employment by ranches or local businesses. Ranchers would be able to perform most additional work with their present labor. Local businesses would benefit from additional purchases made by the ranching families, but this would not warrant hiring new employees.

Other Economic Effects

Tourism and recreation do not currently play major roles in the Granite County economy. The recreation and tourism industry in Granite County has lagged behind most other western Montana counties. The Boulder Creek project would adversely affect the scenic amenities and recreational opportunities available on Boulder Creek, and could further retard development of this industry.

As shown in Appendix A, the Boulder Creek project would change flows below Missoula by less than one percent. Therefore, development of the Boulder Creek project would not affect waste discharge, including the effluent from the City of Missoula and Stone Container Corporation, nor would it alter recreation opportunities on the Clark Fork main stem.

The Boulder Creek project would reduce power production at the hydropower facilities at Milltown, Thompson Falls, and Noxon Rapids. Table 3-3 shows how this impact would be divided between the MPC and WWP. The net annual reduction in hydropower production is equivalent to a 9-hour shutdown of WWP's Noxon Rapids facility. The cost of replacing this lost power would be about $46,000 per year. This cost would be lower in dry years because return flows from the project would be relatively constant, while more water would be diverted in wet years. The

cost of lost generation would be $8,000 with flows that are exceeded in 8 years out of 10 and $98,000 with flows that are exceeded in 2 years out of 10.

WWP and MPC calculated the following charges in generation (Gruel 1988, Woodworth 1988).

Table 3-3. Change in Power Production at MPC's and WWP's Facilities due to GCD's Proposed Boulder Creek Reservoir.

| Month | Average Change in flow, cfs | Change in generation, kWh MPC | WWP | Total |
|---|---|---|---|---|
| October | 1 | 3,869 | 8,779 | 12,648 |
| November | -7 | -26,208 | - 59,472 | - 85,680 |
| December | -8 | -30,950 | - 70,234 | - 101,184 |
| January | -8 | -30,950 | - 70,234 | - 101,184 |
| February | -8 | - 6,509 | - 14,770 | - 21,279 |
| March | -7 | -27,081 | - 61,455 | - 88,536 |
| April | -8 | 0 | - 67,968 | - 67,968 |
| May | -28 | 0 | - 245,817 | - 245,817 |
| June | -30 | 0 | - 254,879 | - 254,879 |
| July | -14 | 0 | -1,229,088 | -1,229,088 |
| August | 12 | 46,426 | 105,350 | 151,776 |
| September | 17 | 63,648 | 144,432 | 208,080 |
| Total Change | | - 7,757 | -1,815,355 | -1,823,111 |

Table 3-4 shows the cumulative impact of the Boulder Creek and Willow Creek projects.

Table 3-4. Change in Power Production at MPC's and WWP's Facilities due to <u>Both</u> of GCD's Proposed Reservoirs.

| Month | Average Change in flow, cfs | Change in generation, kWh MPC | WWP | Total |
|---|---|---|---|---|
| October | 6 | 23,213 | 52,675 | 75,888 |
| November | -4 | -14,976 | - 33,984 | - 48,960 |
| December | -7 | -27,082 | - 61,455 | - 88,536 |
| January | -8 | -30,950 | - 70,234 | - 101,184 |
| February | -7 | - 5,695 | - 12,924 | - 18,619 |
| March | -8 | -30,950 | - 70,234 | - 101,184 |
| April | -15 | 0 | - 127,440 | - 127,440 |
| May | -58 | 0 | - 509,193 | - 509,193 |
| June | -40 | 0 | - 339,839 | - 339,839 |
| July | -14 | 0 | -1,229,088 | -1,229,088 |
| August | 18 | 69,638 | 158,026 | 227,664 |
| September | 24 | 89,856 | 203,904 | 293,760 |
| Total Change | | 73,054 | -2,039,785 | -1,966,731 |

## Public Service Impacts

Construction and operation of the Boulder Creek project would have few effects on public services in Granite County. Increases of late-summer flows are not likely to be sufficient to allow DHES to reduce treatment requirements for the wastewater discharged by Missoula.

The Boulder Creek project would not affect the public and private sector redevelopment activities along the river front in Missoula. Changes in flow would not be visually perceptible and would not affect commercial businesses, public parks, or greenspaces.

## Taxation Impacts

The Boulder Creek irrigation project would increase tax revenues by boosting the taxable values of agricultural lands benefiting from new irrigation and by increasing local cattle production. If GCD retained ownership of the Boulder Creek project facilities, the dam and canal would not be subject to state or local property taxes because the conservation district is a public entity. Sprinkler irrigation equipment is exempt from Montana property taxes, and new equipment purchases associated with expanded irrigation would not affect the area's tax base (Finch 1990).

The Boulder Creek project would increase the amount of irrigated land in the county by 4,093 acres. Most of this land is currently classified as grazing land under the Montana property tax classification system. Based on 1988-89 taxable values for agricultural land, the taxable value of the affected lands would increase from an estimated $4,900 to $44,800, which would be a 0.6 percent increase in the county's total taxable value (Montana Department of Revenue 1989). The new irrigated land would increase county tax revenues by about $3,700, public school tax revenues by $7,600, and Montana university system tax revenues by $240 per year.

Increases in local cattle production could also increase the local tax base. Based on 1988 averages (Montana Department of Revenue 1989), an increase of 5,300 head of cattle could add about $52,000 to the county's tax base. The larger cattle herd would increase county tax revenues by $4,800, local school revenues by $10,000, and university system revenues by $320 per year.

Development of the project facilities would also remove some real and personal property from local tax bases. If GCD acquires ownership of the 145 acres of land flooded by the reservoir above the dam on Boulder Creek which is in the Philipsburg School districts, existing privately owned structures and grazing and forest lands will no longer be subject to property taxes. An additional 206 acres along the canal route would be removed from the tax base.

If the irrigation project increases income for local ranchers and businesses, income taxes paid to the state would increase slightly. But the project would also reduce hydropower revenues (see Table 3-3), which would slightly reduce both corporate income taxes and

state and local property taxes paid by facililty owners.

<u>Boulder Creek and North Fork of Lower Willow Creek Projects</u>

The economic impacts of the proposed North Fork of Lower Willow Creek project are discussed on pages 62 through 64 in the draft EIS (DNRC 1988). DNRC's analyses have found that both projects are economically infeasible and would require substantial subsidies. Annual project returns would have to exceed $358 per acre for the Boulder Creek project and $161 per acre for supplemental water from the North Fork of Lower Willow Creek Project. Even with federal and state subsidies, ranch families investing in these projects would be taking a large financial risk.

If both projects are constructed, the combined economic benefits and costs would be the sum of the benefits and costs of the individual projects. These impacts are described in this addendum and the draft EIS (DNRC 1988).

## ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Of the 25 recorded historical or archaeological sites in the project area, few would be disturbed through construction of the dam, reservoir, and canal system. The town of Princeton lies within 1/4 mile of the upper limit of the proposed reservoir. The project would not disturb existing buildings or other features but could alter the setting of this mining district. A formal evaluation by the Deerlodge National Forest and the State Historic Preservation Office would be necessary to make this determination. Four sites may be disturbed during construction or eventual repair of the canal system. No formal determination has been made on the significance of the information contained in these sites. In addition, three other sites are present on lands to be irrigated with one site having qualities that may make it eligible for listing on the National Register of Historic Places.

Other sites in the project area could suffer due to increased access to the project lands, resulting in vandalism, unauthorized artifact collection, or other acts which damage site integrity. These sites exist on private lands where access is controlled by the landowner, so the potential for these impacts is considered low.

## ALTERNATIVES ANALYZED

DNRC identified five alternatives to GCD's proposal. This investigation was conducted to comply with MEPA and in hopes that an economically feasible alternative could be found. Unfortunately, even though three of the alternatives would result in substantial cost savings, none of the alternatives were economically feasible. Because none of the alternatives were economically feasible, DNRC did not analyze the associated environmental impacts. If GCD's reservation is granted by the Board, some of these alternatives warrant further investigaion prior to construction.

### Canal Modifications

DNRC identified three modifications to the canal route that would decrease long-term costs by mitigating the potential for canal failure. First, with only a small amount of excavation the main canal could be shortened by 4.3 miles. This cutoff is located on the divide between Gird Creek and Douglas Creek (SW, NW, NE, Section 35, Township 9 North, Range 13 West). A 2.2 mile lateral would be needed to service the lands between Gird and Douglas Creeks, but the lateral would only need to be about one tenth the size of the main canal. This modification reduces the amount of land disturbed during construction.

The proposed canal traverses these landslide areas in Section 3, Township 8 North, Range 13 West and Section 35, Township 9 North, Range 13 West. Significant seepage losses and potential canal and slope stability problems could be mitigated by lining the canal when crossing these old landslide areas. Initial construction costs would be higher if these portions of the canal were lined. However, long-term costs associated with seepage and the potential for canal failure would be reduced.

The first four miles of the proposed canal traverse talus slopes and bedrock outcrops along the flank of the Boulder Creek drainage. An unlined canal through talus and blasted bedrock is likely to cause seepage and possible destabilization of the slope. DNRC investigated replacing the first 4.1 miles of the canal with 48-inch diameter steel pipe laid parallel to Boulder Creek from the dam to a point northeast of Maxville. This modification would decrease costs and mitigate seepage and slope stabililty problems. On the other hand, there would be a greater disturbance of the riparian area in Boulder Creek. DNRC estimates that with these modifications the project would cost $32,319,000 to construct (see Appendix B). At this cost, the project is not economically feasible.

### Douglas Creek Alternative

Drainages adjacent to Boulder Creek were investigated for alternative dam sites. The first drainage to the north of Boulder Creek is Gird Creek. No site suitable for storing water in sufficient quantities to irrigate proposed project lands was found in Gird Creek. Further to the north, Douglas Creek does have a potential reservoir site which was identified by DNRC staff during a field investigation on August 17, 1989. Initial engineering analysis showed that the Douglas Creek reservoir site has better storage characteristics than the Boulder Creek dam site. A dam of only 82 feet (hydraulic height) could store approximately 8,000 af compared to the 145-foot dam required at the Boulder Creek site (Oelrich 1989). Furthermore, the potential for loss of life due to dam failure would be reduced at this site.

Based on the promising potential of the site, DNRC analyzed water availability and economic feasibility of the Douglas Creek site. A hydrologic analysis was conducted to evaluate how much land could be reliably supplied from Douglas Creek.

Because no gauging records are available for Douglas Creek, DNRC estimated flows based on basin area, annual precipitation, and gauged flows for streams in the region (Cawlfield 1989). DNRC also reviewed existing water right claims and permits for Douglas Creek water to determine the amount of water available for project use. Using only Douglas Creek flows, the proposed reservoir site yields only approximately 900 af per year for proposed project lands. Assuming an overall delivery efficiency of 32 percent, 900 af per year would be sufficient to supply irrigation water to approximately 260 acres. If overall efficiency were 50 percent, approximately 420 acres could be served. Douglas Creek is clearly limited in its ability to supply water to GCD's project lands.

DNRC then analyzed the possibility of diverting water from Boulder Creek to fill a reservoir in Douglas Creek. To divert water from Boulder Creek would require a diversion dam in Boulder Creek and a canal to bring the water to Douglas Creek. The water would be stored in a reservoir on Douglas Creek. The delivery system beyond this point would be similar to the canal system proposed in GCD's application. Pumping would be required, however, to reach some of the lands.

DNRC staff had already determined the cost of constructing a 100 cfs canal between Boulder Creek and Douglas Creek. While a larger canal would be required, these costs were used in DNRC's economic analysis of the Douglas Creek site. Costs for the diversion structure in Boulder Creek and the dam in Douglas Creek were estimated (see Appendix B). The costs reported in GCD's application for the distribution system were used. No pumping costs were added. The total cost of this alternative was estimated to be $22,525,000.

The $22,525,000 Douglas Creek alternative is less costly than the original Boulder Creek proposal, based on DNRC cost estimates. However, project benefits did not exceed costs in any of the 300 forecast scenarios (see Chapter Four for a brief explanation of DNRC's economic methodology). Because the Douglas Creek alternative is economically infeasible, no additional engineering or environmental analyses were conducted by DNRC.

### Flint Creek Pumping Alternative

DNRC analyzed the possibility of pumping water from Flint Creek up to the proposed canal. Water would be diverted from Flint Creek into a conveyance ditch about 1 and 1/2 miles upstream of the confluence of Flint Creek with Boulder Creek. The pumping plant would be located near Maxville and would pump water up to the main canal. The project beyond this point would be the same as proposed by GCD in its application.

Based on DNRC's analysis, the cost of this alternative would be approximately $17,972,000. This cost includes a one time purchase of water rights for $50 per af. This alternative is not economically feasible and no additional engineering or environmental analyses were conducted by DNRC.

## Granting Less Than Requested

DNRC analyzed the possibility of granting less water than GCD requested. This would be even less feasible than granting the entire amount. An expensive dam and canal system would still be required, even if fewer acres were irrigated. Therefore, reducing the number of irrigated acres only makes the project less feasible to construct. No additional engineering or environmental analyses of this alternative were conducted.

## Deny GCD's Request or No Action

If the Board denies GCD's request, the project could still be constructed. GCD would simply not receive a water right with the associated priority date. Instead, GCD would have to file for a water use permit when the project was ready to be constructed. Because GCD would not receive a priority date, the water that GCD is seeking could be appropriated for another use in the interim. Currently, DFWP is seeking a water reservation to preserve instream flows in Boulder Creek. If the Board grants DFWP's reservation and denies GCD's request, there would not be enough water left unallocated in Boulder Creek for GCD's irrigation project to be constructed in the future.

## CHAPTER FOUR
## BOARD DECISION CRITERIA

This chapter summarizes the preceding analyses in terms of how GCD's Boulder Creek reservation request meets the Board criteria as required by the Administrative Rules of Montana (ARM).

### APPLICANT QUALIFICATIONS AND PURPOSE

For the Board to grant a reservation the Board must find that the applicant is qualified to reserve water and that the purpose of the reservation is a beneficial use (36.16.107b(1)ARM). GCD was organized under the State Conservation District's Act (section 76-15-101, et seq., MCA) passed in 1937. Conservation districts are political subdivisions of the state (76-15-215, MCA). GCD was issued a Certificate of Organization on January 14, 1954. In GCD's application, the stated use of the water is for new irrigation. The statute defines irrigation as a beneficial use (85-2-102, MCA).

### NEED

The Board cannot grant a water reservation unless it finds that the reservation is needed. The Board's rules define a reservation as needed if "there is a reasonable likelihood that future instate or out-of-state competing water uses would consume, degrade, or otherwise affect the water available for the purpose of the reservation" (36.16.107B (2)(a)ARM). The applicant must further show that "there are constraints that would restrict the applicant from perfecting a water permit for the intended purpose of the reservation" (36.16.107B(2)(c)ARM).

Boulder Creek remains open to future appropriations, and until it is closed anyone could file a permit for the same water GCD wishes to reserve. Furthermore, DFWP has requested instream flows on Boulder Creek, Flint Creek, and the Clark Fork main stem which would foreclose GCD's ability, if granted, to develop the project. GCD is pursuing a water reservation rather than a permit because the "project cannot be developed at this time" due to "a lack of capital...and poor market conditions" (GCD 1987).

### AMOUNT

For the Board to grant GCD a reservation, it must determine the amount needed to fulfill the purpose of the reservation based on "accurate and suitable" methodologies and assumptions. The Board must further find that there are no "reasonable cost-effective measures that could be taken within the reservation term to increase the use efficiency and lessen the amount of water required" (36-16.107(3)ARM). GCD has requested that 13,998 af be granted. This amount was determined based on crop needs and projected delivery efficiencies. Once delivered to the fields, the water would be spread using wheelline sprinkler systems. The water would be stored in the 8,500 af reservoir year-round. Diversions would begin in May and

last through September. The maximum diversion rate would be 106.7 cfs (GCD 1987).

DNRC found no economically feasible alternatives that would lessen the amount of water required for the project.

PUBLIC INTEREST

The Board may not grant a reservation without finding that the reservation is in the public interest. This is to be done by weighing and balancing "(a) whether the expected benefits of applying the reserved water to beneficial use are reasonably likely to exceed the costs; (b) whether the net benefits associated with granting a reservation exceed the net benefits of not granting the reservation; (c) whether there are no reasonable alternatives to the proposed reservation that have greater net benefits; (d) whether failure to reserve the water will or is likely to result in an irretrievable loss of a natural resource or an irretrievable loss of a resource development opportunity; and (e) whether there are no significant adverse impacts to public health, welfare, and safety" (36.16.107B(4)ARM).

<u>Expected Benefits and Costs of Applying Water to Proposed Use</u>

The proposed Boulder Creek irrigation project would convert 4,093 acres of rangeland to irrigated farm land. GCD indicates that the project land currently yields 0.25 AUM of grazing per acre per year. This means that 4 acres are needed to support a cow and calf for one month. A typical grazing fee in Montana is $15 per AUM per year (GCD 1987). This translates into an annual return of $3.75 per acre per year. These returns would be lost, but GCD indicates that the project would support grazing at one AUM per acre per year (GCD 1987).

DNRC estimates that the proposed project would cost $30.4 million. This is over twice GCD's estimate of $14.2 million. Appendix B provides tables showing both GCD's and DNRC's cost estimates. Neither of these cost estimates includes the costs of acquiring land for the dam and reservoir, acquiring easements for canals, and relocating the county road that would be flooded by the project. To repay the project's costs, based on DNRC's cost estimates, the project would have to net irrigators an average of $358 per acre per year over the life of the project.

DNRC developed several alternatives to GCD's proposal (See Chapter Three). The cheapest of these alternatives would cost $17.9 million. This alternative would have to bring irrigators an average of $211 per acre per year to repay the project's costs.

DNRC used a computerized simulation model to examine the economics of the project. This model forecasts alfalfa and grain prices, crop yields, and crop production costs for 70 years. Project income was computed for 300 possible combinations of crop prices and stream flows into the reservoir. Based on DNRC's $30.4 million cost estimate, the proposed project did not pay for itself in any of the 300 scenarios. At $17.9 million,

DNRC's cheapest alternative did not pay for itself in any of the 300 scenarios. Only 92 of the 300 scenarios showed project income sufficient to cover GCD's cost estimate of $14.2 million.

Besides the direct benefits of increased crop production, the project would also have indirect benefits. The three indirect benefits would be the recreation opportunities afforded by the reservoir, possible flood control, and increased flows in the lower portion of Flint Creek in late summer.

Indirect costs of the project would include degradation of fish habitat in Boulder Creek below the dam, flooding of wildlife habitat and a section of county road at the reservoir site, and the preclusion of other uses of the water consumed by the project (see Chapter Three). The project would reduce power production from the three hydroelectric plants on the Clark Fork in Montana by 1,823,111 kWh in a typical year. This is an annual cost of $46,000 at current wholesale power rates. The project would reduce power production from Columbia River hydroelectric plants downstream from Montana by 8,000,000 kilowatt-hours in a typical year. At current wholesale power rates, this is an annual cost of $180,000.

## The Net Benefits of Granting versus not Granting the Reservation

Granting GCD a reservation for this project would give the district an earlier priority date than it would have if it were granted a permit when and if the project is built. If the reservation is not granted, unappropriated water may not be available for the project in the future.

There is a direct conflict between granting a reservation on Boulder Creek to GCD for new irrigation and DFWP's instream flow request. DFWP has applied for 20 cfs year-round from Boulder Creek for an instream reservation to protect fish and aquatic habitat, and for all flows from January 1 to April 30 to dilute metals in the Clark Fork. DFWP acknowledges that winter-time dilution flows won't be needed if the ongoing clean-up is successful and metals concentrations reach acceptable levels. Accordingly, DFWP's reservation would be reduced to the amount of water granted year-round to maintain aquatic habitat. GCD's and DFWP's requested reservations would conflict in nine months of every year on average (see Appendix A). Regardless of whether DFWP's request is granted, granting GCD's reservation may preclude more feasible projects.

## Irreversible and Irretrievable Commitment of Resources

### Water

Granting GCD's reservation would commit water for future irrigation. Committing this water to GCD for irrigation may preclude future uses of the water. However, provisions in the Water Use Act require the Board to review reservations at least every 10 years (85-2-316(10) MCA). If the objectives of the reservation

are not being met, the Board may extend, modify, or revoke the reservation in the future.

Land

If the Boulder Creek project is constructed, it would inundate approximately 145 acres of land, the canal would require about 206 acres of land, and 4,093 acres would be irrigated. For all practical purposes, these changes would be irreversible, unless a major reclamation effort were undertaken.

Energy

The consumptive use of water would result in a loss of 1,823,111 kWh during median water years for Montana facilities and an additional 8,000,000 kWh downstream of Montana. In 2 years out of 10, power production would be reduced by 916,000 kWh. Energy lost during project would be irretrievable.

Aquatic Communities

Probable impacts to westslope cutthroat trout and bull trout due to reduced flows are reversible only if water would be returned to the stream. However, the existing trout population may be irretrievably lost if releases are not made from the proposed dam. Possible spawning habitat for bull trout could be lost if the dam is constructed.

Other

Temperature changes in the water below the proposed reservoir are reversible only if water is no longer stored at the proposed dam.

Health, Welfare, and Safety

The Boulder Creek Dam would probably be classified as a high-hazard dam. If the dam is classified as high-hazard, GCD would be required to take steps to reduce any risk of dam failure (36.14.305-312, 401-407,MCA).

Arsenic is a known carcinogen present in the Clark Fork and its tributaries. Arsenic levels in the Clark Fork and Flint Creek exceed state water quality standards (16.20.601 et seq. ARM). The project would reduce the amount of water available to dilute arsenic in Flint Creek and the Clark Fork. This may violate current state water quality standards, depending on arsenic loads a Boulder Creek (see Chapter Three, Water Quality).

Diligence

For the Board to grant a reservation, it must find that the applicant has shown its capability to exercise reasonable diligence toward feasibly financing the proposed projects and applying water to beneficial use in accordance with a management plan (85-2-316(7)MCA). GCD has outlined a series of steps needed to qualify for a U.S. Bureau of Reclamation small project loan in the management plan of its application.

Adverse Effects

For the Board to grant a reservation, it must find that the

reservation, as proposed for adoption, will not adversely affect existing water rights (85-2-316(8)MCA). GCD would divert 13,998 af out of Boulder Creek, resulting in a net annual depletion from Flint Creek of 5,309 af. The water would be diverted year-round. If granted, the reservation would receive a priority date from the date of the Board decision. As a junior user, GCD would have to honor any senior rights.

# APPENDIX A

## Stream Flows and Reservoir Volume

A) Flint Creek at Maxville

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 91 | 74 | 62 | 55 | 62 | 74 | 101 | 148 | 194 | 138 | 117 | 104 | 73,727 |
| 80 Percent | 73 | 54 | 46 | 37 | 43 | 50 | 69 | 99 | 117 | 96 | 99 | 78 | 52,068 |
| 50 Percent | 90 | 74 | 62 | 54 | 55 | 72 | 89 | 132 | 167 | 121 | 117 | 104 | 68,742 |
| 20 Percent | 110 | 91 | 78 | 70 | 83 | 98 | 118 | 191 | 287 | 180 | 132 | 137 | 95,119 |

B) Clark Fork below Confluence with Gold Creek

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 490 | 485 | 433 | 415 | 499 | 573 | 745 | 1,488 | 1,498 | 602 | 291 | 370 | 476,089 |
| 80 Percent | 358 | 394 | 335 | 330 | 374 | 450 | 544 | 929 | 708 | 224 | 161 | 246 | 304,800 |
| 50 Percent | 447 | 475 | 400 | 380 | 453 | 540 | 690 | 1,353 | 1,371 | 493 | 272 | 342 | 435,407 |
| 20 Percent | 591 | 558 | 501 | 496 | 647 | 711 | 902 | 2,155 | 2,156 | 903 | 360 | 479 | 634,866 |

1) Boulder Creek below Proposed Reservoir

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 21 | 21 | 19 | 17 | 17 | 16 | 24 | 102 | 165 | 57 | 19 | 17 | 29,893 |
| 80 Percent | 14 | 16 | 16 | 14 | 14 | 14 | 17 | 67 | 99 | 30 | 11 | 10 | 19,439 |
| 50 Percent | 19 | 20 | 18 | 16 | 16 | 16 | 23 | 94 | 159 | 48 | 17 | 14 | 27,768 |
| 20 Percent | 26 | 26 | 23 | 19 | 18 | 19 | 32 | 138 | 238 | 80 | 26 | 20 | 40,166 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 7 | 7 | 8 | 8 | 9 | 9 | 16 | 70 | 117 | 9 | 4 | 1 | 15,965 |
| 80 Percent | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 28 | 52 | 5 | 4 | 1 | 7,533 |
| 50 Percent | 5 | 5 | 5 | 5 | 5 | 5 | 11 | 65 | 108 | 5 | 4 | 1 | 13,499 |
| 20 Percent | 5 | 5 | 11 | 17 | 17 | 16 | 28 | 107 | 191 | 5 | 4 | 1 | 24,485 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | 14 | 14 | 11 | 9 | 8 | 7 | 8 | 32 | 48 | 48 | 15 | 16 | 13,928 |
| Percent Change | -66.67% | -66.67% | -57.89% | -52.94% | -47.06% | -43.75% | -33.33% | -31.37% | -29.09% | -84.21% | -78.95% | -94.12% | -46.59% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --
(same as "With Proposed Boulder Creek Project")

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 7 | 7 | 8 | 8 | 9 | 9 | 16 | 70 | 117 | 9 | 4 | 1 | 15,965 |
| 80 Percent | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 28 | 52 | 5 | 4 | 1 | 7,533 |
| 50 Percent | 5 | 5 | 5 | 5 | 5 | 5 | 11 | 65 | 108 | 5 | 4 | 1 | 13,499 |
| 20 Percent | 5 | 5 | 11 | 17 | 17 | 16 | 28 | 107 | 191 | 5 | 4 | 1 | 24,485 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--
(same as "With Proposed Boulder Creek Project")

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | 14 | 14 | 11 | 9 | 8 | 7 | 8 | 32 | 48 | 48 | 15 | 16 | 13,928 |
| Percent Change | -66.67% | -66.67% | -57.89% | -52.94% | -47.06% | -43.75% | -33.33% | -31.37% | -29.09% | -84.21% | -78.95% | -94.12% | -46.59% |

2) Boulder Creek at Maxville

- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 26 | 26 | 23 | 20 | 20 | 19 | 29 | 119 | 191 | 63 | 20 | 20 | 34,780 |
| 80 Percent | 18 | 20 | 19 | 17 | 17 | 17 | 20 | 78 | 115 | 32 | 11 | 12 | 22,693 |
| 50 Percent | 24 | 25 | 21 | 19 | 19 | 19 | 26 | 110 | 185 | 53 | 18 | 17 | 32,351 |
| 20 Percent | 33 | 31 | 27 | 22 | 21 | 22 | 37 | 161 | 278 | 90 | 28 | 24 | 46,745 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 13 | 12 | 12 | 11 | 12 | 12 | 21 | 87 | 144 | 18 | 8 | 6 | 21,461 |
| 80 Percent | 10 | 9 | 8 | 8 | 8 | 8 | 8 | 38 | 68 | 9 | 6 | 5 | 11,152 |
| 50 Percent | 11 | 10 | 9 | 8 | 8 | 8 | 15 | 82 | 134 | 12 | 8 | 6 | 18,753 |
| 20 Percent | 12 | 11 | 15 | 21 | 20 | 19 | 33 | 128 | 232 | 18 | 9 | 7 | 30,318 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | 13 | 14 | 11 | 9 | 8 | 7 | 8 | 32 | 47 | 45 | 12 | 14 | 13,319 |
| Percent Change | -50.00% | -53.85% | -47.83% | -45.00% | -40.00% | -36.84% | -27.59% | -26.89% | -24.61% | -71.43% | -60.00% | -70.00% | -38.29% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --
(same as "With Proposed Boulder Creek Project")

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 13 | 12 | 12 | 11 | 12 | 12 | 21 | 87 | 144 | 18 | 8 | 6 | 21,461 |
| 80 Percent | 10 | 9 | 8 | 8 | 8 | 8 | 8 | 38 | 68 | 9 | 6 | 5 | 11,152 |
| 50 Percent | 11 | 10 | 9 | 8 | 8 | 8 | 15 | 82 | 134 | 12 | 8 | 6 | 18,753 |
| 20 Percent | 12 | 11 | 15 | 21 | 20 | 19 | 33 | 128 | 232 | 18 | 9 | 7 | 30,318 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--
(same as "With Proposed Boulder Creek Project")

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | 13 | 14 | 11 | 9 | 8 | 7 | 8 | 32 | 47 | 45 | 12 | 14 | 13,319 |
| Percent Change | -50.00% | -53.85% | -47.83% | -45.00% | -40 00% | -36.84% | -27.59% | -26.89% | -24.61% | -71.43% | -60.00% | -70.00% | -38.29% |

3) Flint Creek Near Mouth

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 197 | 149 | 113 | 93 | 99 | 112 | 167 | 406 | 408 | 88 | 55 | 168 | 124,032 |
| 80 Percent | 154 | 119 | 90 | 73 | 79 | 84 | 112 | 271 | 196 | 34 | 38 | 120 | 82,705 |
| 50 Percent | 201 | 147 | 114 | 92 | 92 | 110 | 150 | 379 | 346 | 37 | 44 | 163 | 113,173 |
| 20 Percent | 236 | 178 | 132 | 114 | 122 | 145 | 213 | 531 | 679 | 127 | 63 | 226 | 166,823 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 198 | 142 | 105 | 85 | 91 | 105 | 159 | 378 | 378 | 74 | 67 | 185 | 118,723 |
| 80 Percent | 163 | 116 | 82 | 63 | 68 | 77 | 102 | 240 | 167 | 36 | 45 | 147 | 78,864 |
| 50 Percent | 202 | 141 | 105 | 81 | 83 | 99 | 137 | 338 | 311 | 40 | 56 | 183 | 107,205 |
| 20 Percent | 230 | 163 | 123 | 104 | 120 | 132 | 213 | 513 | 650 | 93 | 85 | 232 | 160,268 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.51% | -4.70% | -7.08% | -8.60% | -8.08% | -6.25% | -4.79% | -6.90% | -7.35% | -15.91% | 21.82% | 10.12% | -4.28% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 203 | 145 | 106 | 85 | 92 | 104 | 152 | 348 | 368 | 74 | 73 | 192 | 117,193 |
| 80 Percent | 167 | 119 | 82 | 63 | 68 | 77 | 102 | 214 | 166 | 36 | 50 | 149 | 78,057 |
| 50 Percent | 216 | 144 | 107 | 84 | 92 | 115 | 145 | 330 | 345 | 42 | 79 | 196 | 114,356 |
| 20 Percent | 235 | 165 | 124 | 104 | 120 | 131 | 195 | 476 | 626 | 93 | 89 | 234 | 156,284 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 3.05% | -2.68% | -6.19% | -8.60% | -7.07% | -7.14% | -8.98% | -14.29% | -9.80% | -15.91% | 32.73% | 14.29% | -5.51% |

4) Clark Fork below confluence with Flint Creek

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 703 | 675 | 579 | 557 | 668 | 757 | 963 | 1,724 | 1,825 | 768 | 370 | 548 | 611,532 |
| 80 Percent | 519 | 547 | 449 | 434 | 485 | 586 | 689 | 1,068 | 843 | 281 | 201 | 386 | 391,261 |
| 50 Percent | 638 | 660 | 532 | 500 | 612 | 725 | 861 | 1,590 | 1,652 | 624 | 337 | 503 | 556,992 |
| 20 Percent | 844 | 779 | 677 | 652 | 863 | 917 | 1,233 | 2,476 | 2,698 | 1,151 | 516 | 719 | 815,934 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 704 | 668 | 571 | 549 | 660 | 750 | 955 | 1,696 | 1,795 | 754 | 382 | 565 | 606,223 |
| 80 Percent | 529 | 542 | 442 | 423 | 475 | 585 | 677 | 1,040 | 814 | 282 | 207 | 411 | 387,610 |
| 50 Percent | 642 | 652 | 527 | 492 | 607 | 721 | 861 | 1,537 | 1,623 | 626 | 348 | 523 | 552,443 |
| 20 Percent | 840 | 772 | 666 | 639 | 862 | 914 | 1,217 | 2,441 | 2,668 | 1,115 | 538 | 730 | 808,458 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.14% | -1.04% | -1.38% | -1.44% | -1.20% | -0.92% | -0.83% | -1 62% | -1.64% | -1.82% | 3.24% | 3.10% | -0.87% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 709 | 671 | 572 | 549 | 661 | 749 | 948 | 1,666 | 1,785 | 754 | 388 | 572 | 604,693 |
| 80 Percent | 536 | 545 | 443 | 423 | 475 | 585 | 671 | 1,011 | 814 | 283 | 209 | 412 | 386,384 |
| 50 Percent | 647 | 655 | 529 | 492 | 607 | 721 | 841 | 1,495 | 1,611 | 626 | 354 | 530 | 549,350 |
| 20 Percent | 842 | 773 | 667 | 640 | 866 | 914 | 1,214 | 2,411 | 2,660 | 1,116 | 550 | 736 | 807,643 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.85% | -0.59% | -1.21% | -1.44% | -1.05% | -1.06% | -1.56% | -3.36% | -2.19% | -1.82% | 4.86% | 4.38% | -1.12% |

5) Clark Fork above Confluence with Rock Creek

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 785 | 758 | 683 | 615 | 723 | 876 | 1,183 | 1,758 | 1,926 | 909 | 426 | 640 | 680,643 |
| 80 Percen | 603 | 611 | 538 | 456 | 539 | 637 | 802 | 1,020 | 1,081 | 391 | 280 | 456 | 446,930 |
| 50 Percen | 749 | 738 | 653 | 565 | 632 | 814 | 1,092 | 1,531 | 1,623 | 770 | 402 | 572 | 611,965 |
| 20 Percen | 961 | 858 | 753 | 755 | 909 | 1,134 | 1,427 | 2,504 | 2,946 | 1,320 | 536 | 789 | 898,564 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 786 | 751 | 675 | 607 | 715 | 869 | 1,175 | 1,730 | 1,896 | 895 | 438 | 657 | 675,334 |
| 80 Percent | 611 | 608 | 530 | 449 | 528 | 626 | 789 | 968 | 1,052 | 393 | 290 | 482 | 441,621 |
| 50 Percent | 751 | 731 | 648 | 555 | 625 | 813 | 1,078 | 1,522 | 1,594 | 773 | 414 | 591 | 609,239 |
| 20 Percent | 960 | 842 | 753 | 741 | 909 | 1,131 | 1,421 | 2,442 | 2,916 | 1,283 | 554 | 796 | 889,796 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.13% | -0.92% | -1.17% | -1.30% | -1.11% | -0.80% | -0.68% | -1.59% | -1.56% | -1.54% | 2.82% | 2.66% | -0.78% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 791 | 754 | 676 | 607 | 716 | 868 | 1,168 | 1,700 | 1,886 | 895 | 444 | 664 | 673,804 |
| 80 Percent | 617 | 610 | 531 | 449 | 528 | 626 | 795 | 940 | 1,052 | 393 | 291 | 488 | 441,224 |
| 50 Percent | 757 | 734 | 649 | 555 | 625 | 805 | 1,076 | 1,489 | 1,580 | 773 | 419 | 602 | 607,336 |
| 20 Percent | 965 | 844 | 754 | 741 | 909 | 1,119 | 1,400 | 2,403 | 2,908 | 1,284 | 569 | 801 | 886,703 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.76% | -0.53% | -1.02% | -1.30% | -0.97% | -0.91% | -1.27% | -3.30% | -2.08% | -1.54% | 4.23% | 3.75% | -1.00% |

6) Clark Fork below Confluence with Rock Creek

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,068 | 1,001 | 895 | 810 | 933 | 1,119 | 1,708 | 3,507 | 4,088 | 1,712 | 764 | 927 | 1,118,914 |
| 80 Percent | 845 | 826 | 714 | 628 | 730 | 838 | 1,136 | 2,341 | 2,609 | 916 | 555 | 710 | 775,381 |
| 50 Percent | 1,061 | 988 | 870 | 758 | 838 | 1,041 | 1,561 | 3,464 | 3,680 | 1,606 | 734 | 858 | 1,054,750 |
| 20 Percent | 1,259 | 1,122 | 1,021 | 962 | 1,187 | 1,412 | 2,199 | 4,338 | 6,023 | 2,282 | 925 | 1,116 | 1,438,807 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,069 | 994 | 887 | 802 | 925 | 1,112 | 1,700 | 3,479 | 4,058 | 1,698 | 776 | 944 | 1,113,605 |
| 80 Percent | 853 | 822 | 707 | 621 | 719 | 829 | 1,127 | 2,294 | 2,579 | 917 | 565 | 732 | 770,383 |
| 50 Percent | 1,060 | 983 | 860 | 749 | 833 | 1,036 | 1,561 | 3,425 | 3,651 | 1,598 | 745 | 880 | 1,050,006 |
| 20 Percent | 1,259 | 1,108 | 1,013 | 949 | 1,187 | 1,406 | 2,188 | 4,305 | 5,993 | 2,267 | 947 | 1,125 | 1,432,809 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.09% | -0 70% | -0.89% | -0.99% | -0.86% | -0.63% | -0.47% | -0.80% | -0.73% | -0.82% | 1.57% | 1.83% | -0.47% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,074 | 997 | 888 | 802 | 926 | 1,111 | 1,693 | 3,449 | 4,048 | 1,698 | 782 | 951 | 1,112,076 |
| 80 Percent | 860 | 824 | 708 | 621 | 719 | 829 | 1,127 | 2,275 | 2,579 | 918 | 565 | 734 | 770,006 |
| 50 Percent | 1,064 | 985 | 862 | 749 | 833 | 1,036 | 1,562 | 3,383 | 3,651 | 1,598 | 753 | 886 | 1,048,820 |
| 20 Percent | 1,265 | 1,111 | 1,014 | 949 | 1,190 | 1,409 | 2,164 | 4,266 | 5,976 | 2,267 | 956 | 1,132 | 1,429,901 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.56% | -0.40% | -0.78% | -0.99% | -0.75% | -0.71% | -0.88% | -1.65% | -0.98% | -0.82% | 2.36% | 2.59% | -0.61% |

7) Clark Fork above Confluence with Blackfoot

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,073 | 1,028 | 926 | 882 | 1,006 | 1,199 | 1,789 | 3,685 | 4,223 | 1,751 | 805 | 929 | 1,164,983 |
| 80 Percent | 845 | 845 | 733 | 685 | 788 | 893 | 1,183 | 2,483 | 2,685 | 932 | 586 | 702 | 806,260 |
| 50 Percent | 1,064 | 1,012 | 903 | 837 | 900 | 1,122 | 1,612 | 3,645 | 3,797 | 1,627 | 773 | 858 | 1,096,499 |
| 20 Percent | 1,264 | 1,187 | 1,050 | 1,021 | 1,276 | 1,516 | 2,306 | 4,606 | 6,290 | 2,336 | 980 | 1,127 | 1,505,838 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,074 | 1,021 | 918 | 874 | 998 | 1,192 | 1,781 | 3,657 | 4,193 | 1,737 | 817 | 946 | 1,159,674 |
| 80 Percent | 853 | 841 | 730 | 678 | 776 | 845 | 1,179 | 2,436 | 2,655 | 934 | 596 | 723 | 799,354 |
| 50 Percent | 1,066 | 1,006 | 890 | 832 | 895 | 1,120 | 1,612 | 3,636 | 3,767 | 1,623 | 783 | 880 | 1,094,097 |
| 20 Percent | 1,262 | 1,176 | 1,042 | 1,012 | 1,276 | 1,510 | 2,295 | 4,580 | 6,260 | 2,322 | 1,001 | 1,138 | 1,500,692 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0 09% | -0.68% | -0.86% | -0 91% | -0.80% | -0.58% | -0.45% | 0.76% | -0.71% | -0.80% | 1.49% | 1.83% | -0.46% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,079 | 1,024 | 919 | 874 | 999 | 1,191 | 1,774 | 3,627 | 4,183 | 1,737 | 823 | 953 | 1,158,144 |
| 80 Percent | 860 | 843 | 730 | 678 | 776 | 885 | 1,185 | 2,417 | 2,655 | 935 | 597 | 727 | 801,913 |
| 50 Percent | 1,072 | 1,009 | 891 | 832 | 895 | 1,120 | 1,613 | 3,592 | 3,767 | 1,623 | 791 | 886 | 1,092,908 |
| 20 Percent | 1,269 | 1,179 | 1,044 | 1,012 | 1,279 | 1,512 | 2,271 | 4,532 | 6,243 | 2,322 | 1,007 | 1,150 | 1,497,404 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.56% | -0.39% | -0.76% | -0.91% | -0.70% | -0.67% | -0.84% | -1.57% | -0.95% | -0.80% | 2.24% | 2.58% | -0.59 |

8) Clark Fork above Missoula and Bitterroot River

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,776 | 1,702 | 1,550 | 1,466 | 1,645 | 1,998 | 3,789 | 8,918 | 9,692 | 3,723 | 1,667 | 1,638 | 2,390,180 |
| 80 Percent | 1,422 | 1,428 | 1,243 | 1,172 | 1,248 | 1,465 | 2,247 | 6,303 | 6,427 | 2,163 | 1,243 | 1,314 | 1,672,046 |
| 50 Percent | 1,763 | 1,668 | 1,458 | 1,389 | 1,479 | 1,867 | 3,262 | 9,027 | 9,076 | 3,721 | 1,695 | 1,541 | 2,294,183 |
| 20 Percent | 1,971 | 1,928 | 1,842 | 1,749 | 2,055 | 2,521 | 5,281 | 11,408 | 13,388 | 4,982 | 2,010 | 1,877 | 3,080,622 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,777 | 1,695 | 1,542 | 1,458 | 1,637 | 1,991 | 3,781 | 8,890 | 9,662 | 3,709 | 1,679 | 1,655 | 2,384,871 |
| 80 Percent | 1,428 | 1,425 | 1,235 | 1,167 | 1,239 | 1,457 | 2,236 | 6,280 | 6,398 | 2,165 | 1,251 | 1,335 | 1,668,514 |
| 50 Percent | 1,764 | 1,654 | 1,455 | 1,379 | 1,473 | 1,859 | 3,254 | 9,005 | 9,046 | 3,724 | 1,705 | 1,561 | 2,290,161 |
| 20 Percent | 1,964 | 1,916 | 1,843 | 1,744 | 2,054 | 2,515 | 5,271 | 11,401 | 13,358 | 4,960 | 2,031 | 1,884 | 3,076,351 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.06% | -0.41% | -0.52% | -0.55% | -0.49% | -0.35% | -0.21% | -0.31% | -0.31% | -0.38% | 0.72% | 1.04% | -0.22% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 1,782 | 1,698 | 1,543 | 1,458 | 1,638 | 1,990 | 3,774 | 8,860 | 9,652 | 3,709 | 1,685 | 1,662 | 2,383,342 |
| 80 Percent | 1,435 | 1,426 | 1,235 | 1,167 | 1,239 | 1,457 | 2,236 | 6,261 | 6,398 | 2,166 | 1,253 | 1,339 | 1,668,258 |
| 50 Percent | 1,768 | 1,656 | 1,456 | 1,379 | 1,473 | 1,859 | 3,250 | 8,966 | 9,045 | 3,724 | 1,710 | 1,572 | 2,288,854 |
| 20 Percent | 1,968 | 1,919 | 1,844 | 1,745 | 2,059 | 2,517 | 5,248 | 11,384 | 13,337 | 4,960 | 2,038 | 1,890 | 3,074,422 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.34% | -0.24% | -0.45% | -0.55% | -0.43% | -0.40% | -0.40% | -0.65% | -0.41% | -0.38% | 1.08% | 1.47% | -0.29% |

9) Clark Fork below Missoula and Bitterroot River

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 3,079 | 2,973 | 2,700 | 2,487 | 2,773 | 3,294 | 6,334 | 16,238 | 19,485 | 6,867 | 2,570 | 2,679 | 4,317,301 |
| 80 Percent | 2,448 | 2,436 | 2,067 | 1,968 | 2,165 | 2,358 | 3,673 | 11,619 | 13,524 | 3,813 | 1,915 | 2,007 | 3,018,950 |
| 50 Percent | 2,870 | 2,761 | 2,436 | 2,291 | 2,573 | 3,196 | 5,783 | 15,540 | 19,237 | 6,915 | 2,536 | 2,443 | 4,142,727 |
| 20 Percent | 3,671 | 3,513 | 3,524 | 3,027 | 3,483 | 3,975 | 9,187 | 21,189 | 26,439 | 9,113 | 3,097 | 3,368 | 5,650,849 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 3,080 | 2,966 | 2,692 | 2,479 | 2,765 | 3,287 | 6,326 | 16,210 | 19,455 | 6,853 | 2,582 | 2,696 | 4,311,992 |
| 80 Percent | 2,455 | 2,433 | 2,061 | 1,958 | 2,161 | 2,352 | 3,661 | 11,595 | 13,495 | 3,814 | 1,932 | 2,028 | 3,016,067 |
| 50 Percent | 2,870 | 2,754 | 2,428 | 2,281 | 2,566 | 3,186 | 5,770 | 15,493 | 19,207 | 6,899 | 2,545 | 2,468 | 4,135,807 |
| 20 Percent | 3,659 | 3,496 | 3,511 | 3,016 | 3,482 | 3,969 | 9,176 | 21,134 | 26,409 | 9,093 | 3,117 | 3,368 | 5,641,375 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.03% | -0.24% | -0.30% | -0.32% | -0.29% | -0.21% | -0.13% | -0.17% | -0.15% | -0.20% | 0.47% | 0.63% | -0.12% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 3,085 | 2,969 | 2,693 | 2,479 | 2,766 | 3,286 | 6,319 | 16,180 | 19,445 | 6,853 | 2,588 | 2,703 | 4,310,462 |
| 80 Percent | 2,460 | 2,435 | 2,062 | 1,958 | 2,161 | 2,352 | 3,661 | 11,574 | 13,495 | 3,815 | 1,934 | 2,031 | 3,015,626 |
| 50 Percent | 2,873 | 2,757 | 2,429 | 2,281 | 2,566 | 3,186 | 5,759 | 15,452 | 19,207 | 6,899 | 2,551 | 2,483 | 4,134,317 |
| 20 Percent | 3,664 | 3,499 | 3,512 | 3,016 | 3,485 | 3,971 | 9,152 | 21,088 | 26,375 | 9,093 | 3,128 | 3,374 | 5,636,965 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.19% | -0.13% | -0.26% | -0.32% | -0.25% | -0.24% | -0.24% | -0.36% | -0.21% | -0.20% | 0.70% | 0.90% | -0.16% |

10) Clark Fork below Thompson Falls Dam

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12,944 | 13,503 | 14,612 | 15,514 | 15,654 | 14,978 | 21,909 | 48,295 | 55,451 | 26,402 | 10,829 | 10,866 | 15,754,896 |
| 80 Percent | 10,638 | 11,449 | 11,983 | 13,239 | 12,379 | 10,856 | 13,715 | 31,694 | 39,641 | 16,979 | 7,911 | 8,198 | 11,386,180 |
| 50 Percent | 12,745 | 14,032 | 14,836 | 15,712 | 15,835 | 14,231 | 19,488 | 48,823 | 53,916 | 26,131 | 10,811 | 10,960 | 15,549,042 |
| 20 Percent | 15,441 | 15,448 | 16,777 | 17,567 | 19,150 | 18,171 | 32,239 | 64,594 | 71,736 | 34,001 | 13,711 | 13,247 | 20,047,173 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12,945 | 13,496 | 14,604 | 15,506 | 15,646 | 14,971 | 21,901 | 48,267 | 55,421 | 26,388 | 10,841 | 10,883 | 15,749.587 |
| 80 Percent | 10,641 | 11,442 | 11,970 | 13,229 | 12,373 | 10,848 | 13,701 | 31,647 | 39,612 | 16,974 | 7,918 | 8,224 | 11,379,928 |
| 50 Percent | 12,744 | 14,014 | 14,828 | 15,707 | 15,830 | 14,227 | 19,486 | 48,791 | 53,886 | 26,114 | 10,825 | 10,974 | 15,543,362 |
| 20 Percent | 15,445 | 15,447 | 16,767 | 17,567 | 19,145 | 18,166 | 32,231 | 64,581 | 71,706 | 33,960 | 13,730 | 13,260 | 20,042,519 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.01% | -0.05% | -0.05% | -0.05% | -0.05% | -0.05% | -0.04% | -0 06% | -0.05% | -0.05% | 0.11% | 0.16% | -0.03% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12,950 | 13,499 | 14,605 | 15,506 | 15,647 | 14,970 | 21,894 | 48,237 | 55,411 | 26,388 | 10,847 | 10,890 | 15,748,058 |
| 80 Percent | 10,648 | 11,445 | 11,970 | 13,229 | 12,373 | 10,848 | 13,701 | 31,625 | 39,612 | 16,974 | 7,921 | 8,229 | 11,379,666 |
| 50 Percent | 12,749 | 14,016 | 14,829 | 15,707 | 15,830 | 14,227 | 19,479 | 48,775 | 53,886 | 26,114 | 10,833 | 10,987 | 15,543,715 |
| 20 Percent | 15,448 | 15,448 | 16,769 | 17,568 | 19,150 | 18,167 | 32,218 | 64,553 | 71,689 | 33,960 | 13,740 | 13,268 | 20,040,870 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Projects--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.05% | -0.03% | -0.05% | -0.05% | -0.04% | -0.05% | -0.07% | -0.12% | -0.07% | -0.05% | 0.17% | 0.22% | -0.04% |

11) Clark Fork below Noxon Rapids Dam

-- Historical Flows --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12,215 | 12,815 | 14,053 | 14,651 | 15,658 | 16,563 | 22,890 | 45,558 | 55,377 | 25,166 | 10,135 | 10,255 | 15,409,936 |
| 80 Percent | 9,882 | 10,490 | 11,502 | 12,238 | 12,124 | 12,826 | 14,964 | 30,519 | 39,809 | 16,810 | 7,971 | 8,164 | 11,301,796 |
| 50 Percent | 12,164 | 13,045 | 13,539 | 14,944 | 15,414 | 15,702 | 20,714 | 46,708 | 51,305 | 24,699 | 10,044 | 10,359 | 15,011,107 |
| 20 Percent | 14,155 | 15,146 | 16,129 | 16,590 | 19,491 | 19,223 | 29,071 | 59,295 | 70,326 | 32,604 | 12,130 | 12,490 | 19,107,198 |

-- With Proposed Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12,216 | 12,808 | 14,045 | 14,643 | 15,650 | 16,556 | 22,882 | 45,530 | 55,347 | 25,152 | 10,147 | 10,272 | 15,404,627 |
| 80 Percent | 9,885 | 10,484 | 11,491 | 12,227 | 12,118 | 12,822 | 14,951 | 30,466 | 39,780 | 16,804 | 7,978 | 8,193 | 11,295,719 |
| 50 Percent | 12,162 | 13,032 | 13,526 | 14,944 | 15,403 | 15,694 | 20,713 | 46,676 | 51,276 | 24,681 | 10,061 | 10,384 | 15,005,980 |
| 20 Percent | 14,150 | 15,131 | 16,116 | 16,581 | 19,483 | 19,215 | 29,060 | 59,288 | 70,296 | 32,582 | 12,147 | 12,495 | 19,100,827 |

-- Difference between Average Flows: Historical and With Boulder Creek Project --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (1) | 7 | 8 | 8 | 8 | 7 | 8 | 28 | 30 | 14 | (12) | (17) | 5,309 |
| Percent Change | 0.01% | -0.05% | -0.06% | -0.05% | -0.05% | -0.04% | -0.03% | -0.06% | -0.05% | -0.06% | 0.12% | 0.17% | -0.03% |

-- With Proposed Boulder Creek and North Fork of Lower Willow Creek Projects --

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12,221 | 12,811 | 14,046 | 14,643 | 15,651 | 16,555 | 22,875 | 45,500 | 55,337 | 25,152 | 10,153 | 10,279 | 15,403,097 |
| 80 Percent | 9,891 | 10,487 | 11,492 | 12,227 | 12,118 | 12,822 | 14,951 | 30,439 | 39,780 | 16,804 | 7,980 | 8,199 | 11,295,148 |
| 50 Percent | 12,166 | 13,035 | 13,527 | 14,945 | 15,403 | 15,694 | 20,710 | 46,645 | 51,262 | 24,681 | 10,067 | 10,395 | 15,004,633 |
| 20 Percent | 14,152 | 15,133 | 16,117 | 16,581 | 19,487 | 19,215 | 29,047 | 59,255 | 70,279 | 32,582 | 12,155 | 12,500 | 19,098,327 |

--Difference between Average Flows: Historical and With Boulder Creek and North Fork of Lower Willow Creek Project--

| | OCT (cfs) | NOV (cfs) | DEC (cfs) | JAN (cfs) | FEB (cfs) | MAR (cfs) | APR (cfs) | MAY (cfs) | JUN (cfs) | JUL (cfs) | AUG (cfs) | SEP (cfs) | ANNUAL (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference | (6) | 4 | 7 | 8 | 7 | 8 | 15 | 58 | 40 | 14 | (18) | (24) | 6,839 |
| Percent Change | 0.05% | -0.03% | -0.05% | -0.05% | -0.04% | -0.05% | -0.07% | -0.13% | -0.07% | -0.06% | 0.18% | 0.23% | -0.04% |

Boulder Creek Reservoir Volume (af)

| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 2,275 | 3,147 | 3,946 | 4,657 | 5,227 | 5,707 | 6,170 | 6,880 | 8,354 | 8,487 | 5,967 | 2,473 |
| 80 Percent | 15 | 880 | 1,554 | 2,316 | 2,848 | 3,541 | 4,018 | 5,110 | 8,500 | 8,500 | 4,772 | 803 |
| 60 Percent | 841 | 1,629 | 2,487 | 3,281 | 3,919 | 4,540 | 5,279 | 6,139 | 8,500 | 8,500 | 5,397 | 1,482 |
| 50 Percent | 1,353 | 2,529 | 3,445 | 4,381 | 5,144 | 5,727 | 6,354 | 7,725 | 8,500 | 8,500 | 5,605 | 1,741 |
| 40 Percent | 2,780 | 3,857 | 4,760 | 5,644 | 6,389 | 7,145 | 7,831 | 8,500 | 8,500 | 8,500 | 6,490 | 2,933 |
| 20 Percent | 4,379 | 5,647 | 6,334 | 7,274 | 8,021 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 7,686 | 4,747 |
| Maximum | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 | 7,324 |
| Minimum | 0 | 182 | 772 | 1,437 | 1,707 | 1,903 | 2,328 | 3,445 | 6,273 | 7,949 | 3,079 | 0 |

# APPENDIX B

## Project Costs

Table B-1. Boulder Creek Cost Summary for Irrigation Delivery System, On-farm System, and Storage Facilities[a]

| | Total Cost | Annual Cost | | O&M | |
|---|---|---|---|---|---|
| | $ | Yrs | $ | % | $ |
| DELIVERY SYSTEM | | | | | |
| Conveyance | | | | | |
| Canals | $2,611,800 | 50 | $143,100 | 1.0% | $ 26,100 |
| Inlets | 78,000 | 50 | 4,300 | 1.0 | 800 |
| Pipelines | 1,207,400 | 50 | 66,100 | 1.0 | 12,100 |
| Turnouts | 82,800 | 50 | 4,500 | 1.0 | 800 |
| Pres. Red. | 42,000 | 50 | 2,300 | 1.0 | 400 |
| Eng. & Admin. | 607,100 | 50 | 33,300 | | |
| Interest | 101,200 | 50 | 5,500 | | |
| On-farm | | | | | |
| Sprinklers | 1,191,000 | 20 | 95,600 | 1.5 | 17,900 |
| Labor | | | | | 17,300 |
| Total Cost | 5,946,300 | | 356,100 | | 75,400 |
| Total Annual Cost | | | | | 431,500 |
| Per Acre Annual Cost | | | | | 99.63 |
| STORAGE FACILITIES | | | | | |
| Earthwork | 3,215,000 | 50 | 176,100 | | |
| Outlet Works | | | | | |
| 770' 30" Conduit | 28,200 | | | | |
| 30" Sluicegate | 31,500 | | | | |
| 30" Butterfly valve | 6,000 | | | | |
| Labor | 20,000 | | | | |
| Total | 85,700 | 50 | 4,700 | 1.0 | 900 |
| Emergency Spillway | 1,050,000 | 50 | 57,500 | | |
| Contingency (20%) | 870,100 | 50 | 47,700 | | |
| Hidden Cost (10%) | 435,100 | 50 | 23,800 | | |
| Eng. & Admin (15%) | 848,400 | 50 | 46,500 | | |
| Interest | 141,400 | 50 | 7,700 | | |
| Total Cost | 6,645,700 | | 364,000 | | 900 |
| Total Annual Cost | | | | | 364,900 |
| Per Acre Annual Cost | | | | | 84.25 |
| TOTAL PROJECT COST[b] | | | | | 12,592,000 |
| ANNUAL PROJECT COST | | | | | 796,400 |
| PER ACRE PROJECT COST | | | | | 183.88 |

[a]Taken directly from GCD (1987)

[b]Cited in the text as $14.2 million, which includes the present value of O&M costs of $76,300.

Table B-2. DNRC Project Costs Estimate[a]

| Item | Capital Cost | O&M |
|---|---|---|
| Embankment costs[b] | 8,663,000 | 86,600 |
| Spillway | 4,490,000 | 44,900 |
| Outlet works | 1,150,000 | 11,500 |
| Canal Costs[c] | 2,612,000 | 26,100 |
| Wheelline costs[d] | 2,397,000 | 35,200 |
| In-field distribution[e] | 1,410,000 | 14,100 |
| Sub-total | 20,722,000 | 218,400 |
| Contigency (15%) | 3,108,000 | |
| Eng., admin., and legal (10%) | 2,072,000 | |
| Total | 25,902,000 | |
| Present Value | 30,446,000 | |
| Discount rate | 4.6% | |
| Planning Period | 70 | |
| Cost per acre | 7,439 | |
| Cost per acre per year | 358 | |
| Acres | 4,093 | |

[a]Because recent bids for embankment costs were 38 percent lower than cost estimates using U.S. Bureau of Reclamation cost curves, DNRC reduced cost estimates for spillway and outlet works based on U.S. Bureau of Reclamation cost curves by 38 percent. Table B-3 presents project costs using the higher U.S. Bureau of Reclamation cost estimates.

[b]$5.25 per cubic yard (Griffith 1988).

[c]GCD 1987.

[d]Present value of purchasing wheellines, which have a useful life of 15 years and cost $1,191,000 (GCD 1987) per purchase.

[e]Includes costs for inlets, pipelines, turnouts, and pressure reducers (GCD 1987).

Table B-3. Boulder Creek Reservoir[a]
DNRC Project Costs Estimate

| Item | Capital Cost | O&M |
|---|---|---|
| Embankment costs[b] | 8,663,000 | 86,600 |
| Spillway | 7,242,000 | 72,400 |
| Outlet works | 1,855,000 | 18,600 |
| Canal Costs[c] | 2,612,000 | 26,100 |
| Wheelline costs[d] | 2,397,000 | 35,200 |
| In-field distribution[e] | 1,410,000 | 14,100 |
| Sub-total | 24,179,000 | 253,000 |
| Contigency (15%) | 3,627,000 | |
| Eng., admin., and legal (10%) | 2,418,000 | |
| Total | 30,224,000 | |
| Present Value | 35,488,000 | |
| Discount rate | 4.6% | |
| Planning Period | 70 | |
| Cost per acre | 8,670 | |
| Cost per acre per year | 417 | |
| Acres | 4,093 | |

[a]Based on U.S. Bureau of Reclamation cost curves (Griffith 1988).

[b]$5.25 per cubic yard (Griffith 1988).

[c]GCD 1987.

[d]Present value of purchasing wheellines, which have a useful life of 15 years and cost $1,191,000 (GCD 1987) per purchase.

[e]Includes costs for inlets, pipelines, turnouts, and pressure reducers (GCD 1987).

Table B-4. Canal Modification Alternative
DNRC Project Costs Estimate

| Item | Capital Cost | O&M |
|---|---|---|
| Embankment costs[a] | 8,663,000 | 86,600 |
| Spillway[b] | 4,490,000 | 44,900 |
| Outlet works[b] | 1,150,000 | 11,500 |
| Canal Costs[c] | 1,215,000 | 12,200 |
| Pipe Cost[c] | 2,680,000 | 26,800 |
| Wheelline costs[d] | 2,397,000 | 35,200 |
| In-field distribution[e] | 1,410,000 | 14,100 |
| Sub-total | 22,005,000 | 231,300 |
| Contigency (15%) | 3,301,000 | |
| Eng., admin., and legal (10%) | 2,201,000 | |
| Total | 27,507,000 | |
| Present Value | 32,319,000 | |
| Discount rate | 4.6% | |
| Planning Period | 70 | |
| Cost per acre | 7,896 | |
| Cost per acre per year | 380 | |
| Acres | 4,093 | |

[a]$5.25 per cubic yard (Griffith 1988).

[b]Because recent bids for embankment costs were 38 percent lower than cost estimates using U.S. Bureau of Reclamation cost curves, DNRC reduced cost estimates for spillway and outlet works based on U.S. Bureau of Reclamation cost curves by 38 percent.

[c]Canal and pipeline modifications, alternative 3 (Cawlfield 1989).

[d]Present value of purchasing wheellines, which have a useful life of 15 years and cost $1,191,000 (GCD 1987) per purchase.

[e]Includes costs for inlets, pipelines, turnouts, and pressure reducers (GCD 1987).

Table B-5. Douglas Creek Alternative
DNRC Project Costs Estimate

| Item | Capital Cost | O&M |
|---|---|---|
| Dam costs[a] | 5,292,000 | 52,900 |
| Canal Costs[b] | 5,990,000 | 59,900 |
| Diversion[c] | 200,000 | 2,000 |
| Wheelline costs[d] | 2,397,000 | 35,200 |
| In-field distribution[e] | 1,410,000 | 14,100 |
| Sub-total | 15,289,000 | 164,100 |
| Contigency (15%) | 2,293,000 | |
| Eng., admin., and legal (10%) | 1,529,000 | |
| Total | 19,111,000 | |
| Present Value | 22,525,000 | |
| Discount Rate | 4.6% | |
| Planning Period | 70 | |
| Cost per acre | 5,503 | |
| Cost per acre per year | 265 | |
| Acres | 4,093 | |

[a]$5.25 per cubic yard (Griffith 1988); roller compacted concrete design (Greiman 1989).

[b]Canal alternative 1, as GCD proposed plus lining (Cawlfield 1989).

[c]Diversion in Boulder Creek.

[d]Present value of purchasing wheellines, which have a useful life of 15 years and cost $1,191,000 (GCD 1987) per purchase.

[e]Includes costs for inlets, pipelines, turnouts, and pressure reducers (GCD 1987).

Table B-6. Flint Creek Pumping Alternative
DNRC Project Costs Estimate

| Item | Capital Cost | O&M |
|---|---|---|
| Pump[a] | 668,000 | 351,100 |
| Pump Controls[b] | 67,000 | 700 |
| Diversion[c] | 212,000 | 2,100 |
| Pipe[d] | 383,000 | 1,900 |
| Diversion Ditch[e] | 32,000 | 1,600 |
| Road Crossing[f] | 100,000 | |
| Purchased Water[g] | 700,000 | |
| Canal Cost[h] | 1,405,000 | 14,100 |
| Wheelline costs[i] | 2,397,000 | 35,200 |
| In-field distribution[j] | 1,410,000 | 14,100 |
| Sub-total | 7,374,000 | 420,800 |
| Contigency (15%) | 1,106,000 | |
| Eng., admin., and legal (10%) | 737,000 | |
| Total | 9,217,000 | |
| Present Value | 17,972,000 | |
| Discount Rate | 4.6% | |
| Planning Period | 70 | |
| Cost per acre | 4,391 | |
| Cost per acre per year | 211 | |
| Acres | 4,093 | |

[a]6,200 horse power pump, 2.5 percent O&M, and $334,406/year in energy costs.
[b]10 percent of pump cost.
[c]Diversion in Flint Creek; 106 cfs at $2,000 per cfs.
[d]Steel pipe serving the main canal above Maxville.
[e]Ditch to move water from Flint Creek to pumping station below Maxville.
[f]Crossing Highway 1.
[g]14,000 af at $50.00 per af.
[h]Canal costs (GCD 1987) less 3.9 miles of canal.
[i]Present value of purchasing wheellines, which have a useful life of 15 years and cost $1,191,000 (GCD 1987) per purchase.
[j]Includes costs for inlets, pipelines, turnouts, and pressure reducers (GCD 1987).

# APPENDIX C

## GCD Correspondence

July 27, 1989

Karen L. Barclay, Director
Department of Natural Resources and Conservation
1520 East 6th Avenue
Helena, Montana 59620-2301

Dear Karen:

The Granite Conservation District is confirming its commitment to the Boulder Creek project and fully intends to pursue the project throughout the reservation process. It is unfortunate that there has been confusion over this point. This letter is intended to clarify our position so that this issue will not cause any further delays in the process.

Sincerely,

Jim Dinsmore

Jim Dinsmore, Chairman
Granite Conservation District

cc Dr. William Shields, Chairman
Board of Natural Resources and Conservation

jt

# APPENDIX D

## Flint Creek Water Quality

Water Quality Data for Flint Creek
All Values in mg/L

| Date | Total Nitrogen | Total Phosphorous | TR[a] Silver | Total Arsenic | TR Cadmium | TR Copper | TR Iron | TR Mercury | TR Lead | TR Zinc | Hardness | Total Sulfate | Flow (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SPRING** | | | | | | | | | | | | | |
| 04/18/79 | <0.01 | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | 146 | 17.3 | 166 |
| 05/10/79 | 0.04 | 0.07 | -- | -- | -- | -- | -- | -- | -- | 126 | 16.6 | -- | |
| 06/14/79 | 0.01 | 0.06 | -- | -- | -- | -- | -- | -- | -- | -- | 139 | 12.4 | -- |
| 04/25/84 | -- | -- | -- | -- | -- | <0.01 | 0.49 | -- | -- | 0.04 | -- | -- | -- |
| 05/08/84 | -- | -- | -- | -- | -- | <0.01 | 0.30 | -- | -- | 0.12 | -- | -- | 100.9 |
| 05/15/84 | -- | -- | -- | -- | -- | 0.03 | 1.66 | -- | -- | 0.26 | -- | -- | 325 |
| 05/22/84 | -- | -- | -- | -- | -- | <0.01 | 0.41 | -- | -- | 0.03 | -- | -- | 270 |
| 05/30/84 | -- | -- | -- | -- | -- | <0.01 | 0.65 | -- | -- | 0.08 | -- | -- | 284 |
| 06/05/84 | -- | -- | -- | -- | -- | <0.01 | 0.34 | -- | -- | 0.03 | 98 | -- | 305 |
| 06/12/84 | -- | -- | -- | -- | -- | <0.01 | 0.32 | -- | -- | 0.02 | 110 | -- | 339 |
| 06/19/84 | -- | -- | -- | -- | -- | <0.01 | 0.21 | -- | -- | 0.03 | 89 | -- | 325 |
| 06/27/84 | -- | -- | -- | -- | -- | <0.01 | 0.34 | -- | -- | 0.03 | 91 | -- | -- |
| 04/15/86 | -- | -- | -- | -- | <0.001 | 0.009 | 0.60 | -- | 0.009 | 0.03 | 110 | -- | 214 |
| 05/28/86 | -- | -- | -- | -- | <0.001 | 0.015 | -- | -- | -- | -- | 60 | -- | 386 |
| 04/29/87 | -- | -- | -- | 0.018 | <0.001 | 0.010 | 1.30 | -- | 0.016 | 0.050 | 92 | -- | 102 |
| 05/27/87 | -- | -- | -- | 0.031 | <0.001 | 0.016 | 2.30 | -- | <0.005 | 0.110 | 180 | -- | 101 |
| 04/20/88 | -- | -- | -- | 0.019 | 0.001 | 0.013 | 1.00 | -- | 0.013 | 0.015 | 130 | -- | 114 |
| **SUMMER** | | | | | | | | | | | | | |
| 08/22/78 | 0.05 | 0.127 | -- | -- | <0.005 | <0.01 | -- | -- | -- | 0.017 | -- | 32.0 | 115 |
| 08/24/78 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 30.0 | 113 |
| 08/22/79 | 0.02 | 0.105 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 30.84 |
| 09/19/79 | <0.01 | 0.060 | -- | -- | -- | -- | -- | -- | -- | -- | 218 | 34.9 | 89 |
| 07/03/84 | -- | -- | -- | -- | -- | <0.01 | 0.22 | -- | -- | 0.040 | 117 | -- | 205 |
| 07/16/84 | -- | -- | -- | -- | -- | <0.01 | 0.12 | -- | -- | 0.010 | 160 | -- | -- |
| 08/08/84 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 07/11/87 | -- | -- | -- | 0.016 | <0.001 | 0.008 | 0.510 | -- | 0.014 | 0.030 | 210 | -- | 93 |
| 07/19/87 | -- | -- | -- | 0.015 | <0.001 | 0.007 | 0.480 | -- | <0.005 | 0.030 | 200 | -- | 151 |
| 09/02/87 | -- | -- | -- | 0.013 | <0.001 | 0.007 | 0.190 | -- | <0.005 | <0.010 | 260 | -- | 7.6 |
| **FALL** | | | | | | | | | | | | | |
| 10/06/78 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 25.0 | 249 |
| 11/16/78 | 0.16 | 0.03 | -- | -- | -- | <0.01 | -- | -- | -- | 0.01 | -- | 22.5 | 157.6 |
| 10/24/79 | 0.02 | 0.05 | -- | -- | -- | -- | -- | -- | -- | -- | 179 | 25.6 | 152 |
| 11/20/79 | 0.13 | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | 172 | 19.4 | 117 |
| **WINTER** | | | | | | | | | | | | | |
| 03/27/74 | -- | -- | -- | -- | <0.01 | 0.01 | 1.5 | -- | -- | 0.09 | 119 | 22.5 | 175 |
| 02/22/79 | 0.20 | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | 153 | 16.4 | -- |
| 03/15/79 | 0.10 | 0.19 | -- | -- | -- | -- | -- | -- | -- | -- | 153 | 19.5 | 160 |
| 01/31/80 | 0.35 | 0.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 24.2 | -- |
| 02/25/86 | -- | -- | -- | -- | <0.001 | 0.029 | 4.7 | -- | 0.056 | 0.170 | -- | -- | 892 |

[a]TR = Total recoverable.
Source: DHES 1988; USDI 1986, 1987, 1988b.

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